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KEY TO ESSENTIALS OF ARITHMETIC

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The Sensenig-Anderson Series of Arithmetics

KEY

TO

ESSENTIALS OF ARITHMETIC

BY

DAVID M. SENSENIG, M.S.

AND

ROBERT F. ANDERSON, A.M.

INSTRUCTORS IN MATHEMATICS, STATE NORMAL SCHOOL
WEST CHESTER, PENNSYLVANIA

SILVER, BURDETT AND COMPANY
NEW YORK BOSTON CHICAGO

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PREFACE

THE object of this Key is to relieve overburdened teachers using "Essentials of Arithmetic," and to assist the inexperienced ones by placing within their reach solutions of numerous problems with which they are, perhaps, not familiar.

To counteract the tendency of some teachers to depend solely on a Key in the preparation of their work, not all solutions are fully given, in some cases little more than a suggestion being supplied. A sufficient number of problems, however, are completely solved to acquaint the teacher with correct forms.

Most of the abstract problems involve nothing that the teacher cannot explain without previous preparation; hence but few of them are solved.

THE AUTHORS.

Exercise 17, Page 25.

Islands.	Exports.		Imports.	
	1899.	1897.	1899.	1897.
Porto Rico	$3,677,564	$2,023,751	$3,416,681	$1,943,251
Cuba	24,861,261	9,308,515	29,619,759	16,233,456
Philippines	1,663,213	69,459	4,903,467	4,352,181
Total	$30,202,038	$11,401,725	$37,939,907	$22,528,888

Islands.	Increase in Exports in 1899 over 1897.	Increase in Imports in 1899 over 1897.	Increase in Exports above Increase in Imports.
Porto Rico	$1,653,813	$1,473,430	$180,383
Cuba	15,552,746	13,386,303	2,166,443
Philippines	1,593,754	551,286	1,042,468
Total	$18,800,313	$15,411,019	$3,389,294

Exercise 40, Page 63.

25. The greatest weight that each ball can have is contained a whole number of times in 18 lb. and 24 lb.

∴ it is the g. c. m. of 18 lb. and 24 lb., which is 6 lb.

26. The length of the longest panel must be the g. c. m. of 160 ft. and 136 ft., which is 8 ft.

2 × 160 ft. : 8 ft. = 40 = the number of panels in the two lengths.
2 × 136 ft. : 8 ft. = 34 = the number of panels in the two widths.
∴ 40 + 34 = 74 = the number of panels required in all.

27. The highest average paid = g. c. m. of $24, $30, and $36, which is $6.

28. The length of the longest sticks = the g. c. m. of 28 ft., 42 ft., and 56 ft., which is 14 ft.

29. The length of the longest measure = the g. c. m. of 32 ft., 28 ft., and 16 ft., which is 4 ft.

30. The greatest length of the fishing lines = the g. c. m. of 210 ft., 350 ft., and 525 ft., which is 35 ft.

31. The number of acres in each farm = the g. c. m. of 385, 462, and 539, which is 77.

(385 + 462 + 539) : 77 = 18 = the number of farms required.

32. The number of bushels in each load = the g. c. m. of 225, 315, and 360, which is 45.

33. The highest price paid = the g. c. m. of \$852 – \$5, \$973 – \$5, and \$1094 – \$5 = the g. c. m. of \$847, \$968, and \$1089, which is \$121.

Exercise 42, Page 67.

23. The smallest amount of hay = the smallest amount that contains 100 lb. and 125 lb. each.

∴ it is the l. c. m. of 100 lb. and 125 lb., which is 500 lb.

24. The smallest sum of money he must take is the smallest sum that is a whole number of times 24 ct. and 28 ct., which is the l. c. m. of 24 ct. and 28 ct., or 168 ct.

168 ct. : 24 ct. = 7 = the number of pounds of the first kind.

168 ct. : 28 ct. = 6 = the number of pounds of the second kind.

25. The width of the narrowest walk = the least width that contains 20 in. and 12 in., which is the l. c. m. of 20 in. and 12 in., or 60 in.

26. The time required is the least time that is a whole number of times 6 min. and 8 min., which is the l. c. m. of 6 min. and 8 min., or 24 min.

∴ 24 is the number of minutes.

27. The length of the shortest rod is the least length that is a whole number of times 6 in., 8 in., and 10 in.

∴ it is the l. c. m. of 6 in., 8 in., and 10 in., which is 120 in.

28. The number of days that must elapse before they leave together again = the l. c. m. of 5, 12, and 15, which is 60.

The number of days that must elapse before the first and the third leave together = the l. c. m. of 5 and 15, which is 15.

∴ 60 : 15 = 4 = the number of times the first and third have left together, including the first time, and 3 = the number of times they left together in the meantime.

KEY

TO

ESSENTIALS OF ARITHMETIC.

Exercise 12, Page 17.

11.

CLASS.	MON.	TUES.	WED.	THURS.	FRI.	SAT.	TOTAL.
Fiction	756	864	795	791	794	1219	5219
Fine Arts	427	487	498	489	490	521	2912
History	685	714	716	725	698	797	4335
Literature	427	450	461	418	429	548	2733
Philosophy	89	101	100	99	102	181	672
Religion	125	150	170	167	192	307	1111
Science	347	355	361	355	379	409	2206
Sociology	214	225	229	237	244	318	1467
Total	3070	3346	3330	3281	3328	4300	20655

12.

LAKE.	TROUT.		WHITE FISH.		TOTAL.
	1890.	1898.	1890.	1898.	
Superior	2,613,378	4,342,122	3,213,176	2,769,088	12,928,764
Michigan	8,364,167	8,216,920	5,455,079	4,833,691	26,869,857
Huron	1,505,619	3,439,575	1,004,094	1,222,687	7,171,975
Erie	121,420	203,132	2,341,451	1,292,410	3,958,413
Ontario	41,010	6,024	148,771	45,380	241,185
Total	12,645,594	16,207,773	12,162,571	10,163,256	51,179,194

Exercise 17, Page 25.

ISLANDS.	EXPORTS.		IMPORTS.	
	1899.	1897.	1899.	1897.
Porto Rico	$3,677,564	$2,023,751	$3,416,681	$1,943,251
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2 × 136 ft. : 8 ft. = 34 = the number of panels in the two widths.

∴ 40 + 34 = 74 = the number of panels required in all.

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24. The smallest sum of money he must take is the smallest sum that is a whole number of times 24 ct. and 28 ct., which is the l. c. m. of 24 ct. and 28 ct., or 168 ct.

168 ct. : 24 ct. = 7 = the number of pounds of the first kind.

168 ct. : 28 ct. = 6 = the number of pounds of the second kind.

25. The width of the narrowest walk = the least width that contains 20 in. and 12 in., which is the l. c. m. of 20 in. and 12 in., or 60 in.

26. The time required is the least time that is a whole number of times 6 min. and 8 min., which is the l. c. m. of 6 min. and 8 min., or 24 min.

∴ 24 is the number of minutes.

27. The length of the shortest rod is the least length that is a whole number of times 6 in., 8 in., and 10 in.

∴ it is the l. c. m. of 6 in., 8 in., and 10 in., which is 120 in.

28. The number of days that must elapse before they leave together again = the l. c. m. of 5, 12, and 15, which is 60.

The number of days that must elapse before the first and the third leave together = the l. c. m. of 5 and 15, which is 15.

∴ 60 : 15 = 4 = the number of times the first and third have left together, including the first time, and 3 = the number of times they left together in the meantime.

29. The whole number of eggs is the least number that exactly contains 8, 12, and 20, which is the l. c. m. of 8, 12, and 20, or 120.

30. The smallest tract of land is the least that exactly contains 60 A., 120 A., or 180 A., which is the l. c. m. of these amounts, or 360 A.

31. The shortest log is 2 ft. more than the l. c. m. of 12 ft., 10 ft., and 24 ft., which is 120 ft. + 2 ft., or 122 ft.

32. The least sum of money required is $50 less than the l. c. m. of $100, $120, and $150, which is $600 – $50, or $550.

33. The weight of the smallest block required is 20 lb. more than the l. c. m. of 160 lb., 240 lb., and 360 lb., which is 1440 lb. + 20 lb., or 1460 lb.

34. The number of bushels of grain he had is 40 more than the l. c. m. of 48, 56, and 60, which is 1680 + 40, or 1720.

Exercise 43, Page 69.

42. 273 × 56 lb. = the weight of 6 loads.

$\therefore \frac{273 \times 56 \text{ lb.}}{6} = 2548$ lb. = the average weight per load.

43. 54 × $50 = the value of the land.

12 × $15 = the amount saved per year.

$\therefore \frac{54 \times \$50}{12 \times \$15} = 15$ = the number of years required.

44. 6 × 24 = the number of days' work 18 men must do.

Whence, $\frac{6 \times 24}{18}$, or 8 = the number of days each man must work.

∴ 18 men must be given 8 da. to do the work.

45. 10 × 30 × 60 lb. = the weight of the wheat.

2000 lb. = the weight of 1 T. of wheat.

$\therefore \frac{10 \times 30 \times 60 \text{ lb.}}{2000 \text{ lb.}}$, or 9 = the number of tons.

46. 24 × 12 × 10 = the number of hours of work done in all.

10 × 8 = the number of hours of work done by 1 man by the second condition.

$\therefore \frac{24 \times 12 \times 10}{10 \times 8}$, or 36 = the number of men by the second condition.

47. $8 \times 60 \times 16$ qt. = the amount of oats eaten.

12×20 qt. = the amount of oats eaten by 1 horse by the first condition.

$\therefore \frac{8 \times 60 \times 16 \text{ qt.}}{12 \times 20 \text{ qt.}}$, or 32 = the number of horses by the first condition.

Exercise 44, Page 73.

16. The highest average price is the g. c. m. of $381, $889, and $1143, which, by successive division, is found to be $127.

$381 : $127 = 3 = the number $381 would buy.
$889 : $127 = 7 = the number $889 would buy.
$1143 : $127 = 9 = the number $1143 would buy.

17. The price paid per acre was the g. c. m. of $1608, $2345, and $2814, which is $67.

$1608 : $67 = 24 = the number of acres A received.
$2345 : $67 = 35 = the number of acres B received.
$2814 : $67 = 42 = the number of acres C received.

18. The largest sum of money is the g. c. m. of $1489 – $10 and $1663 – $10, which equals the g. c. m. of $1479 and $1653, or $87.

Exercise 45, Page 45.

15. The sum of money required = the l. c. m. of $680 and $850, which is $3400.

16. The least amount of iron required is 40 lb. more than the l. c. m. of 273 lb., 420 lb., and 504 lb., which is 32,760 lb. + 40 lb., or 32,800 lb.

17. The amount of flour I have = the l. c. m. of 25 lb., 50 lb., 100 lb., and 196 lb., which is 4900 lb.

18. The g. c. d. of 42 and 70 = 14.
The l. c. m. of 42 and 15 = 210.
$42 \times 70 \div 14 = 210$.
$\therefore$ the product of 42 and 70 divided by their g. c. d. = their l. c. m.

19. Let N and n be any two numbers.

Now, $\frac{N}{\text{g. c. d.}} \times n = \text{l. c. m.}$ [§ 110.]

$\therefore N \times n = \text{g. c. d.} \times \text{l. c. m.}$

Exercise 60, Page 99.

57. To make $\frac{1}{10}$ of a cubic foot of ice, it will require $\frac{1}{11}$ of a cubic foot of water, and to make $\frac{10}{10}$, or 1 cu. ft. of ice, it will require $10 \times \frac{1}{11}$, or $\frac{10}{11}$ of a cubic foot of water.

58. $\$640 = \frac{4}{3}$ of his salary the second year.

$\therefore$ $\frac{3}{4}$ of $\$640 = \$480$ = his salary the second year.

$\$480 = \frac{4}{3}$ of his salary the first year.

$\therefore$ $\frac{3}{4}$ of $\$480 = \$360$ = his salary the first year.

59. 2500 ft. $\div 2\frac{1}{2} =$ 5000 ft. $\div 5 =$ 1000 ft. = the distance it traveled per second.

60. $2\frac{2}{3} \times$ the distance around the track = 1 mi.

$\therefore$ 1 mi. $\div 2\frac{2}{3} =$ 3 mi. $\div 8 = \frac{3}{8}$ mi. = the distance around the track.

61. $6\frac{5}{9} \times$ the cost of the harness = the cost of both = \$118.

$\therefore$ $\$118 \div 6\frac{5}{9} = \$1062 \div 59 = \$18$ = the cost of the harness.

And, $\$118 - \$18 = \$100$ = the cost of the horse.

62. $\frac{15}{15} - \frac{8}{15}$, or $\frac{7}{15}$ of the weight of a bushel of wheat = the difference of the weight of a bushel of wheat and a bushel of oats = 28 lb.

$$\therefore 28 \text{ lb.} \div \tfrac{7}{15} = \frac{15 \times 28 \text{ lb.}}{7} = 60 \text{ lb.} = \text{the weight of a bushel of wheat.}$$

And $\frac{8}{15}$ of 60 lb. = 32 lb. = the weight of a bushel of oats.

63. $$1\tfrac{24}{25} \div \left(\frac{\overset{2}{\cancel{8}}}{9} \times \frac{7}{\underset{3}{\cancel{12}}}\right) = \frac{49}{25} \div \frac{14}{27} = \frac{27}{\underset{2}{\cancel{14}}} \times \frac{\overset{7}{\cancel{49}}}{25} = \frac{189}{50} = \text{the third fraction.}$$

Exercise 62, Page 103.

40. $(\cancel{37\tfrac{1}{2}} \times 18\tfrac{3}{4}) : (\cancel{37\tfrac{1}{2}} : 18\tfrac{3}{4}) = 18\tfrac{3}{4} : (1 : 18\tfrac{3}{4})$ [§ 102.]
$= \frac{75}{4} : (4 : 75) = \frac{75}{4} : \frac{4}{75} = \frac{75}{4} \times \frac{75}{4} = 351\frac{9}{16}$.

41. $(\frac{2}{3} + \frac{3}{4}) : (17 \div 12) = \frac{17}{12} : \frac{17}{12} = 1$.

42. $(\frac{5}{4}$ of $57\frac{1}{7}) : (1\frac{11}{16} - \frac{2}{3}) = \frac{5}{\cancel{4}}$ of $\frac{\overset{100}{\cancel{400}}}{7} : 1\frac{1}{48} = \frac{500}{7} : \frac{49}{48} = \frac{48}{49} \times \frac{500}{7}$ || $\frac{24000}{343} = 69\frac{333}{343}$.

43. $(37\frac{1}{2} + 25) : (37\frac{1}{2} - 25) = 62\frac{1}{2} : 12\frac{1}{2} = 5$.

44. $(\frac{5}{16} + 37\frac{1}{2} - 12\frac{1}{2}) : (62\frac{1}{2} - 50 + 6\frac{1}{4}) = 25\frac{5}{16} : 18\frac{3}{4} = \frac{405}{16} : \frac{75}{4}$

$$= \frac{\cancel{4}}{\underset{15}{\cancel{75}}} \times \frac{\overset{81}{\cancel{405}}}{\underset{4}{\cancel{16}}} = \tfrac{81}{60} = 1\tfrac{7}{20}.$$

50. $6 \times 12\frac{1}{2}$ ct. : $11\frac{1}{4}$ ct. $= 75 : \frac{45}{4} = 300 : 45$, or $6\frac{2}{3}$ = the number of pounds of lard required.

51. $31\frac{1}{2} : 2\frac{3}{4} = 126 : 11 = 11\frac{5}{11}$ = the number of times the bucket can be filled.

53. $\$42\frac{1}{2}$, or $\$\frac{85}{2}$ = the cost.
$\$\frac{1}{2} = \frac{1}{85}$ of the cost.
Whence, $\$1 = \frac{2}{85}$ of the cost.
And, $\$2\frac{1}{8}$, or $\$\frac{17}{8} = \frac{\cancel{17}}{\underset{4}{\cancel{8}}} \times \frac{2}{\underset{5}{\cancel{85}}}$ of the cost, or $\frac{1}{20}$ of the cost.
$\therefore$ the loss $= \frac{1}{20}$ of the cost.

54. $\$75\frac{3}{4} = \$\frac{303}{4}$ = the selling price.
$\$\frac{1}{4} = \frac{1}{303}$ of the selling price.
And, $\$1 = \frac{4}{303}$ of the selling price.
Whence, $\$6\frac{3}{50}$ or $\$\frac{303}{50} = \frac{303}{50} \times \frac{4}{303}$ of the selling price $= \frac{2}{25}$ of the selling price.
$\therefore$ The agent was paid $\frac{2}{25}$ of the selling price.

55. 1000 lb. : $18\frac{3}{16}$ lb. $= 16000 : 291 = \frac{16000}{291}$ = the number of times $18\frac{3}{16}$ lb. that equals 1000 lb.
$\therefore \frac{16000}{291} \times 100$ = the number of feet of fence 1000 lb. will make.
And, $(\frac{16000}{291} \times 100) : 16\frac{1}{2}$, or $333\frac{2201}{9603}$ = the number of rods 1000 lb. will make.
$\therefore 333\frac{1}{4}$ = the required number.

Exercise 63, Page 106.

21. $\frac{2 + \frac{2}{3}}{2 - \frac{2}{3}} = \frac{3(2 + \frac{2}{3})}{3(2 - \frac{2}{3})} = \frac{6 + 2}{6 - 2} = \frac{8}{4} = 2.$

22. $\frac{4 + 2\frac{1}{12}}{5 - 1\frac{5}{6}} = \frac{12(4 + 2\frac{1}{12})}{12(5 - 1\frac{5}{6})} = \frac{48 + 25}{60 - 22} = \frac{73}{38} = 1\frac{35}{38}.$

23. $\frac{\frac{8}{9} - \frac{2}{3}}{\frac{5}{9} - \frac{1}{3}} = \frac{9(\frac{8}{9} - \frac{2}{3})}{9(\frac{5}{9} - \frac{1}{3})} = \frac{8 - 6}{5 - 3} = \frac{2}{2} = 1.$

24. $\frac{5\frac{3}{4} - \frac{2}{3}}{3\frac{1}{4} + \frac{1}{12}} = \frac{12(5\frac{3}{4} - \frac{2}{3})}{12(3\frac{1}{4} + \frac{1}{12})} = \frac{69 - 8}{39 + 1} = \frac{61}{40} = 1\frac{21}{40}.$

25. $\frac{12\frac{1}{2} + 6\frac{1}{4}}{18\frac{3}{4} - 3\frac{1}{8}} = \frac{8(12\frac{1}{2} + 6\frac{1}{4})}{8(18\frac{3}{4} - 3\frac{1}{8})} = \frac{100 + 50}{150 - 25} = \frac{150}{125} = 1\frac{1}{5}.$

26. $$\frac{\frac{3}{100}+\frac{9}{50}+\frac{4}{25}+\frac{3}{5}}{\frac{92}{100}-\frac{23}{50}+\frac{12}{25}-\frac{16}{25}}=\frac{100(\frac{3}{100}+\frac{9}{50}+\frac{4}{25}+\frac{3}{5})}{100(\frac{92}{100}-\frac{23}{50}+\frac{12}{25}-\frac{16}{25})}=\frac{3+18+16+60}{92-46+48-64}$$
$$=\frac{97}{30}=3\tfrac{7}{30}.$$

27. $$\frac{\frac{3-\frac{1}{5}}{4}-\frac{3+\frac{1}{5}}{8}}{16}=\frac{40\left(\frac{3-\frac{1}{5}}{4}-\frac{3+\frac{1}{5}}{8}\right)}{40\times 16}=\frac{30-2-(15+1)}{40\times 16}=\frac{12}{40\times 16}=\frac{3}{160}.$$

28. $$\frac{(\frac{2}{3}+\frac{3}{4})\times(\frac{3}{4}-\frac{2}{3})}{(\frac{9}{16}-\frac{4}{9})\div(\frac{2}{3}+\frac{3}{4})}=\frac{\frac{17}{12}\times\frac{1}{12}}{\frac{17}{144}\div\frac{204}{144}}=\frac{\frac{17}{144}}{\frac{17}{204}}=\frac{204}{\cancel{17}}\times\frac{\cancel{17}}{144}=\frac{51}{36}=1\tfrac{5}{12}.$$

Exercise 65, Page 110.

4. $$\frac{2(\frac{9}{15}+\frac{17}{40})}{\frac{1}{3}(\frac{9}{15}-\frac{17}{40})}=\frac{120(\frac{18}{15}+\frac{17}{20})}{120(\frac{3}{15}-\frac{17}{120})}=\frac{144+102}{24-17}=\frac{246}{7}=35\tfrac{1}{7}.$$

5. Sug. 1256 sq. yd. = 12.56 hundred sq. yd.

8. $$\frac{\overset{2}{\cancel{8}}}{\underset{3}{\cancel{9}}}\times\frac{\cancel{3}}{\cancel{4}}+\frac{1}{3}\div\frac{1}{4}\times 2\tfrac{1}{2}-1\tfrac{1}{4}=\frac{2}{3}+\frac{\overset{2}{\cancel{4}}}{3}\times\frac{5}{\cancel{2}}-\frac{5}{4}=\frac{2}{3}+\frac{10}{3}-\frac{5}{4}=2\tfrac{3}{4}.$$

9. $\overset{5}{\cancel{20}}\times 15\times\frac{7}{\cancel{4}}$ lb. = 525 lb. = the amount of meat required.

10. \$6800 − \$3000 = \$3800 = the value of 60 A. of land.
∴ $\frac{1}{60}$ of \$3800 = \$63$\frac{1}{3}$ = the value of the land per acre.

11. $\frac{4}{5}$ of the cost = \$100.
∴ $\frac{1}{5}$ of the cost = \$25 = the amount of the note.

12. 4 times the amount the daughter received = \$125.
Whence, the amount the daughter received = \$31$\frac{1}{4}$.
And, the amount the son received = \$93$\frac{3}{4}$.

13. $\frac{9}{10}$ of the amount used = 144 lb.
∴ the amount used = 144 lb. ÷ $\frac{9}{10}$ = $\frac{1440}{9}$ lb. = 160 lb.

14. $\frac{3}{4}$ of number − 10 = $\frac{7}{12}$ of number.
∴ $\frac{3}{4}$ of number − $\frac{7}{12}$ number = 10.
Whence, $\frac{1}{6}$ number = 10, and the number = 6 × 10 = 60.

15. $\frac{3}{4}$ of width = $\frac{2}{3}$ of length.
∴ width = $\frac{4}{3}$ of $\frac{2}{3}$, or $\frac{8}{9}$, of length.
And, $\frac{2}{3}$ of width = $\frac{2}{3}$ of $\frac{8}{9}$, or $\frac{16}{27}$, of length.

16. $37\frac{1}{2}$ mi. : 10 mi. = $\frac{15}{4}$; whence, $37\frac{1}{2}$ mi. = $\frac{15}{4}$ of 10 mi.
$\therefore$ $\frac{15}{4} \times \frac{5}{2}$ in. = $9\frac{3}{8}$ in. = the distance on the map between the two places.

17. Three hundred four six hundred twenty-second.

18. 3 bu. out of 8 bu. of the mixture is oats.
$\therefore$ $\frac{3}{8}$ of 20 = $7\frac{1}{2}$ = the number of bushels of oats.
5 bu. out of 8 bu. of the mixture is corn.
$\therefore$ $\frac{5}{8}$ of 20 = $12\frac{1}{2}$ = the number of bushels of corn.

19. 196 lb. : $43\frac{5}{9}$ lb. = $\frac{9}{2}$; whence, 196 lb. = $\frac{9}{2}$ of $43\frac{5}{9}$ lb.
$\therefore$ $\frac{9}{2}$ of 60 = 270 = the number of pounds of wheat required.

20. $\frac{3}{3}$ of B's + $\frac{2}{3}$ of B's = $\frac{5}{3}$ of B's = $\$5000$.
Whence, B's = $\frac{3}{5}$ of $\$5000$ = $\$3000$.
And, A's = $\frac{2}{3}$ of B's = $\$2000$.

21. 8 qt. out of 9, or $\frac{8}{9}$ of the mixture was pure milk.
$\therefore$ $\frac{8}{9}$ of 108 qt. = 96 qt. = the amount of pure milk.

22. The selling price of $\frac{3}{4}$ of the article = $\frac{7}{8}$ of the cost of the article.
$\therefore$ the selling price of the whole article = $\frac{4}{3}$ of $\frac{7}{8}$ = $\frac{7}{6}$ of the cost.

23. $3\frac{1}{3} : 10 = \frac{1}{3}$; whence $3\frac{1}{3} = \frac{1}{3}$ of 10.
$\therefore$ $\frac{1}{3}$ of $\frac{3}{5}$, or $\frac{1}{5}$, is taken to represent $3\frac{1}{3}$.

24. $\frac{3}{2}$ ct. = the cost of 1 banana.
$\frac{2}{3}$ ct. = the cost of 1 apple.
$\therefore$ $\frac{3}{2}$ ct. + $\frac{2}{3}$ ct. = $\frac{13}{6}$ ct. = the cost of 1 banana and 1 apple.
$\therefore$ 52 ct. : $\frac{13}{6}$ ct. = 24 = the whole number of each bought.

25. $2\frac{1}{2}$ rd. : 4 rd. = $\frac{5}{8}$; whence, $2\frac{1}{2}$ rd. = $\frac{5}{8}$ of 4 rd.
$\therefore$ $2\frac{1}{2}$ rd. = $\frac{5}{8}$ of 66 ft. = $41\frac{1}{4}$ ft.

26. $60\frac{2}{3}$ ft. : $12\frac{1}{2}$ ft. = $\frac{364}{75}$; whence, $60\frac{2}{3}$ ft. = $\frac{364}{75}$ of $12\frac{1}{2}$ ft.

$$\therefore\ \frac{364}{\underset{15}{\cancel{75}}} \text{ of } \overset{2}{\cancel{10}} \text{ ft.} = 48\tfrac{8}{15} \text{ ft.} = \text{the length of the flagpole.}$$

27. $(14\frac{2}{7} \times 18\frac{3}{4} \times 87\frac{1}{2} \times 37\frac{1}{2}) \div (12\frac{1}{2} \times 100 \times 1\frac{9}{16} \times 3\frac{1}{8})$

$$= \left(\frac{100}{7} \times \frac{75}{4} \times \frac{175}{2} \times \frac{75}{2}\right) \div \left(\frac{25}{2} \times 100 \times \frac{25}{16} \times \frac{25}{8}\right)$$

$$= \frac{\cancel{100}}{\cancel{7}} \times \frac{\overset{3}{\cancel{75}}}{\cancel{4}} \times \frac{\overset{\cancel{7}}{\cancel{175}}}{\cancel{2}} \times \frac{\overset{3}{\cancel{75}}}{\cancel{2}} \times \frac{\cancel{2}}{\cancel{25}} \times \frac{1}{\cancel{100}} \times \frac{16}{\cancel{25}} \times \frac{\cancel{8}}{\cancel{25}} = 144.$$

28. $10\frac{3}{4}$ yd. : $\frac{3}{4}$ yd. = $\frac{43}{4}$ yd. : $\frac{3}{4}$ yd. = $14\frac{1}{3}$.
$\therefore$ 14 vests, with $\frac{1}{4}$ yd. over, may be obtained.

29. 4 × the time going down = 75 min.
∴ the time going down = $\frac{1}{4}$ of 75 min. = $18\frac{3}{4}$ min.
And, 3 × the time going down = $\frac{3}{4}$ of 75 min. = $56\frac{1}{4}$ min.
= the time going up.

30. $\frac{1}{9}$ = the part A can do in 1 da.
$\frac{1}{6}$ = the part A and B can do in 1 da.
∴ $\frac{1}{6} - \frac{1}{9} = \frac{1}{18}$ = the part B can do in 1 da.
Whence, $1 : \frac{1}{18} = 18$ = the number of days it will take B.

31. \$300 − \$50 = \$250 = the cost.
\$1 = $\frac{1}{250}$ of the cost.
∴ \$50 = $\frac{50}{250} = \frac{1}{5}$ of the cost.
Whence, $\frac{1}{5}$ of the cost = the gain.

32. $31\frac{1}{2}$ gal. − $4\frac{1}{2}$ gal. = 27 gal. = the amount left.
27 gal. : $31\frac{1}{2}$ gal. = $\frac{6}{7}$; whence, 27 gal. = $\frac{6}{7}$ of $31\frac{1}{2}$ gal.
∴ the amount left = $\frac{6}{7}$ of the barrel.

33. $\frac{9}{9} - \frac{2}{9} = \frac{7}{9}$ = the part of his salary left.
∴ $\frac{7}{9}$ of his salary = \$$15\frac{3}{4}$ = \$$\frac{63}{4}$.
Whence, his salary = $\frac{9}{7}$ of \$$\frac{63}{4}$ = \$$20\frac{1}{4}$.

34. $7\frac{7}{8}$ pt. : $\frac{3}{8}$ pt. = 63 : 3 = 21 = the number of jars.

35. $2\frac{1}{2}$ ft. : $3\frac{3}{4}$ ft. = $\frac{2}{3}$; whence, the circumference of the smaller wheel = $\frac{2}{3}$ of the circumference of the larger wheel.
∴ $\frac{3}{2}$ of 100 = 150 = the number of revolutions the smaller wheel must make.

36. 54 yr. + $17\frac{1}{2}$ yr. = $71\frac{1}{2}$ yr. = the age he should attain.

37. $\frac{1}{2}$ lb. + $\frac{1}{4}$ lb. + $\frac{1}{8}$ lb. = $\frac{7}{8}$ lb. = the weight of 1 package of each.
∴ 14 lb. : $\frac{7}{8}$ lb. = 16 = the number of packages of each there are.

38. 24 yd. − ($2\frac{1}{2}$ yd. + $3\frac{3}{4}$ yd. + $12\frac{1}{8}$ yd.) = 24 yd. − $18\frac{3}{8}$ yd. = $5\frac{5}{8}$ yd. = the amount remaining.

$$\therefore\ 5\tfrac{5}{8} \times \$1\tfrac{1}{3} = \frac{\overset{15}{\cancel{45}}}{\underset{2}{\cancel{8}}} \times \$\frac{\cancel{4}}{\cancel{3}} = \$7\tfrac{1}{2} = \text{the value of the remainder.}$$

39. $$1\tfrac{1}{3} \div \left(\frac{5}{4} \times \frac{8}{9}\right) = \frac{4}{\cancel{3}} \times \frac{\cancel{4}}{5} \times \frac{\overset{3}{\cancel{9}}}{\underset{2}{\cancel{8}}} = \frac{12}{10} = \frac{6}{5} = \text{the other fraction.}$$

40. 20 × 6 × \$$1\frac{1}{4}$ = \$150 = the amount of money required.

41. $10 : 4 + 10 : 2 = 7\frac{1}{2}$ = the number of days required.

42. $\frac{4}{7}$ of the weight of a bushel of corn = 32 lb.
∴ the weight of a bushel of corn = $\frac{7}{4}$ of 32 lb. = 56 lb.

43. $\$60 - \$24\frac{1}{4} = \$35\frac{3}{4}$ = the amount to be saved.
$\$1\frac{2}{3} - \$\frac{3}{4} = \$\frac{11}{12}$ = the amount saved in 1 da.
∴ $\$35\frac{3}{4} : \$\frac{11}{12} = \$429 : \$11 = 39$ = the number of days required.

44. $75 \div 1\frac{3}{4} = 300 \div 7 = 42\frac{6}{7}$ = the number of gallons the first skims in 1 hr.
∴ $42\frac{6}{7} + 60 = 102\frac{6}{7}$ = the number of gallons both skim in 1 hr.
Whence, $150 \div 102\frac{6}{7} = 1\frac{11}{24}$ = the number of hours required.

45. $7\frac{1}{2} \times 10$ ct. = 75 ct. = the cost of the turkey.
75 ct. + 15 ct. = 90 ct. = the selling price of the turkey.
$\frac{3}{4}$ of $\frac{15}{2}$ lb. = $\frac{45}{8}$ lb. = the amount of turkey sold.
∴ 90 ct. $\div \frac{45}{8} = \frac{8}{45}$ of 90 ct. = 16 ct. = the selling price per pound.

46. 3×45 ct. = 135 ct. = the value of 3 lb. of green tea.
1×60 ct. = 60 ct. = the value of 1 lb. of black tea.
∴ 135 ct. + 60 ct. = 195 ct. = the value of 4 lb. of the mixture.
Whence, 195 ct. $\div 4 = 48\frac{3}{4}$ ct. = the value of 1 lb. of the mixture.

47. $\frac{10}{11}$ of $62\frac{1}{2}$ lb. = $\frac{10}{11}$ of $\frac{125}{2}$ lb. = the weight of 1 cu. ft. of ice.

$$\therefore\ 2000 \text{ lb.} : \frac{10}{11} \text{ of } \frac{125}{2} \text{ lb.} = \frac{11}{\underset{5}{\cancel{10}}} \times \frac{\cancel{2}}{\cancel{125}} \times \overset{16}{\cancel{2000}} = 35\tfrac{1}{5} = \text{the number}$$

of cubic feet of ice required.

48. $2000 : 62\frac{1}{2} = 4000 : 125 = 32$ = the number of cubic feet.

49. $$\frac{1 - \frac{1}{4} \times 1 + \frac{1}{4} \div 1 + \frac{1}{4} \times 1 - \frac{1}{4}}{1 \times \frac{1}{4} + 1 \div \frac{1}{4}} = \frac{1 - \frac{1}{4} + \frac{1}{4} + \frac{1}{4} - \frac{1}{4}}{\frac{1}{4} + 4} = \frac{1}{4\frac{1}{4}} = \frac{4}{17}.$$

50. On 10 dailies he gained 10 ct.
On 1 Sunday Press he gained 2 ct.
∴ $12\frac{1}{2}$ ct. = the amount he gained in all every time he sold 10 dailies and 1 Sunday paper.
∴ 75 ct. : $12\frac{1}{2}$ ct. = 6 = the number of Sunday papers he sold.

51. $\frac{2}{3}$ of the smaller = $\frac{2}{5}$ of the larger.
∴ the smaller = $\frac{3}{2}$ of $\frac{2}{5}$, or $\frac{3}{5}$ of the larger.
Whence, $\frac{8}{5}$ of the larger = their sum = 120.
∴ the larger = $\frac{5}{8}$ of 120 = 75; and $\frac{3}{5}$ of the larger, or the smaller = $\frac{3}{8}$ of 120 = 45.

52. $\$6000 = \frac{6}{5}$ of $\$5000$.

$\therefore \frac{6}{5}$ of $\$33\frac{1}{3} = \frac{\overset{2}{\cancel{6}}}{\cancel{5}}$ of $\frac{\overset{20}{\$\cancel{100}}}{\cancel{3}} = \$40 =$ the amount of rent charged on the latter house.

55. B's share $+ 29\frac{3}{4}$ A. = A's share.
B's share = B's share.
$\therefore$ 2 B's share $+ 29\frac{3}{4}$ A. = the whole tract $= 160\frac{2}{3}$ A.
Whence, 2 B's share $= 160\frac{2}{3}$ A. $- 29\frac{3}{4}$ A. $= 130\frac{11}{12}$ A.
And, B's share $= \frac{1}{2}$ of $130\frac{11}{12}$ A. $= 65\frac{11}{24}$ A.
And, A's share $= 65\frac{11}{24}$ A. $+ 29\frac{3}{4}$ A. $= 95\frac{5}{24}$ A.

56. $$\frac{\frac{3}{4} \times \frac{2}{3} \div 2 + \frac{4}{5} - \frac{3}{10} \div \frac{1}{20} \times \frac{1}{6}}{\frac{\frac{\cancel{3}}{\cancel{4}}}{\frac{\cancel{2}}{\cancel{3}}} \times \frac{\frac{\cancel{2}}{\cancel{3}}}{\frac{\cancel{3}}{\cancel{4}}} \div 20} = \frac{\frac{1}{4} + \frac{4}{5} - 1}{\frac{1}{20}} = 5 + 16 - 20 = 1.$$

57. $\frac{83\frac{1}{3}}{100}$, or $\frac{5}{6}$ of the cost $= \$8\frac{3}{4} = \$\frac{35}{4}$.

$\therefore \frac{\overset{3}{\cancel{6}}}{\cancel{5}}$ of $\frac{\overset{7}{\$\cancel{35}}}{\underset{2}{\cancel{4}}} = \$10\frac{1}{2} =$ the cost.

Whence, $\$10\frac{1}{2} - \$8\frac{3}{4} = \$1\frac{3}{4} =$ the loss.

Exercise 71, Page 120.

12. $.75 + .675 + .8125 = 2.2375 = 2.2\frac{375}{1000} = 2.2\frac{3}{8}$.

13. $1.125 + .16\frac{2}{3} + 4.814\frac{2}{7} = 1.125 + .166\frac{2}{3} + 4.814\frac{2}{7} = 6.105\frac{20}{21} = 6.1\frac{5\frac{20}{21}}{100} = 6.1\frac{125}{2100} = 6.1\frac{5}{84}$.

14. $.2 + 1.125 + .6215 = 1.9465 = 1.94\frac{65}{100} = 1.94\frac{13}{20}$.

15. $.000\frac{7}{8} + \frac{2}{3} + .375 = .000\frac{7}{8} + .666\frac{2}{3} + .375 = 1.042\frac{13}{24} = 1.04\frac{2\frac{13}{24}}{10} = 1.04\frac{61}{240}$.

27. $.42 - .375 = .045 = .0\frac{45}{100} = .0\frac{9}{20}$.

28. $.2 - .18\frac{3}{4} = .01\frac{1}{4} = .0\frac{1\frac{1}{4}}{10} = .0\frac{1}{8}$.

29. $2\frac{3}{4} - .16\frac{2}{3} = 2.75 - .16\frac{2}{3} = 2.58\frac{1}{3} = 2.5\frac{8\frac{1}{3}}{10} = 2.5\frac{25}{30} = 2.5\frac{5}{6}$.

30. $.2 - .125 = .075 = .07\frac{5}{10} = .07\frac{1}{2}$.

31. $3 - \frac{7}{8} = 2\frac{1}{8} = 2.12\frac{1}{2}$.

32. $\frac{1}{3} - .2 = .33\frac{1}{3} - .20 = .13\frac{1}{3}$.

33. $33\frac{3}{8} + .625 - .0875 + 2.37\frac{1}{2} - .06\frac{1}{4} = 33\frac{3}{8} + \frac{5}{8} - \frac{7}{80} + 2\frac{3}{8} - \frac{1}{16} = 34 - \frac{7}{80} + 2\frac{30}{80} - \frac{5}{80} = 34 + 2\frac{18}{80} = 36\frac{9}{40}$.

40. \$275.95 − (\$127.80 + \$25.75) + \$35.75 = \$311.70 − \$153.55 = \$158.15 = the amount in his balance.

41. $4.008 + 18.0400 + 6.06 + 600.06 + 6034.4 + 9.009 = 6671.577$.

42. 12.1 ft − 3.7 ft. = 8.4 ft. = the height above low-water mark.

Exercise 72, Page 123.

22. $12 \times 2.2\frac{7}{9} = 12 \times 2.27\frac{7}{9} = 27.33\frac{1}{3}$.

23. $5\frac{1}{2} \times .037\frac{1}{2} = 5\frac{1}{2} \times .0375 = .20625 = .20\frac{625}{1000} = .20\frac{5}{8}$.

24. $.16 \times 4.0\frac{1}{3} = .645\frac{1}{3} = .64\frac{5\frac{1}{3}}{10} = .64\frac{16}{30} = .64\frac{8}{15}$.

25. $.0\frac{5}{6} \times 3.24 = .270 = .27$.

36. 2 × 1.17 × 62.5 lb. = 146.25 lb. = the weight of the plank.

37. $6\frac{2}{3}$ × .06 × \$600 = $6\frac{2}{3}$ × \$36 = \$240 = the amount paid.

38. 100 × 3.1416 × $2\frac{1}{3}$ ft. = 314.16 × $2\frac{1}{3}$ ft. = 733.04 ft. = the distance the bicycle moved.

Exercise 73, Page 125.

31. $.2\frac{2}{9} \div 5 = \frac{1}{5}$ of $\frac{2\frac{2}{9}}{10} = \frac{1}{5}$ of $\frac{2}{9} = \frac{2}{45}$.

32. $.066\frac{2}{3} \div 16 = \frac{1}{16}$ of $\frac{66\frac{2}{3}}{1000} = \frac{1}{16}$ of $\frac{200}{3000} = \frac{1}{16}$ of $\frac{1}{15} = \frac{1}{240}$.

33. $1 \div .33\frac{1}{3} = 1 \div \frac{1}{3} = 3$.

34. $2 \div 75 = \frac{1}{75}$ of $2.00 = .02\frac{2}{3}$.

35. $6.5 \div 8 = \frac{1}{8}$ of $6.50 = .81\frac{1}{4}$.

36. $1 \div 400 = 1 \div (100 \times 4) = .01 \div 4 = .00\frac{1}{4}$.

37. $2\frac{2}{3} \div 11 = \frac{1}{11}$ of $2.66\frac{2}{3} = .24\frac{2\frac{2}{3}}{11} = .24\frac{8}{33}$.

38. $3\frac{3}{4} \div 2\frac{1}{8} = 8 \times 3\frac{3}{4} \div 8 \times 2\frac{1}{8} = 30 \div 17 = \frac{1}{17}$ of $30.00 = 1.76\frac{8}{17}$.

39. $2\frac{2}{3} \div 20 = (3 \times 2\frac{2}{3}) \div (3 \times 20) = 8 \div 60 = 2 \div 15 = \frac{1}{15}$ of $2.00 = .13\frac{1}{3}$.

40. 13.5 ct. ÷ 2.25 = 1350 ct. ÷ 225 = 6 ct. = the price per pound.

44. \$1 = the cost of .125 of a bushel.

∴ \$1 = the cost of $\frac{1}{8}$ of a bushel.

Whence, \$8 = the cost of 1 bu.

45. $.66\frac{2}{3}$, or $\frac{2}{3}$ of the crop $= 400$ bu.
$\therefore$ $\frac{3}{2}$ of 400 bu. $= 600$ bu. $=$ the crop.

47. $\frac{1}{50}$ of 2932 lb. $= 58.64$ lb. $=$ the average weight per bushel.
$\therefore$ 60 lb. $-$ 58.64 lb. $= 1.36$ lb. $=$ the loss of weight per bushel.

48. \$26.95 $=$ the selling price of 3.85 cwt.
Whence, \$2695 $=$ the selling price of 385 cwt.
$\therefore$ \$2695 $\div$ 385 $=$ \$7 $=$ the price per hundredweight.

53. .4 or $\frac{2}{5}$ of the weight of a cubic foot of graphite $= 62.5$ lb.
$\therefore$ 62.5 lb. $\div \frac{2}{5} = \frac{5}{2}$ of 62.5 lb. $= 156.25$ lb. $=$ the weight of a cubic foot of graphite.

Exercise 74, Page 128.

13. $.02\frac{3}{7} : 4 = \dfrac{2\frac{3}{7}}{100} : 4 = \frac{17}{700} : 4 = \frac{1}{4}$ of $\frac{17}{700} = \frac{17}{2800}$.

14. $75 : .2\frac{1}{3} = 75 : \frac{7}{30} = 2250 : 7 = \frac{1}{7}$ of $2250 = 321\frac{3}{7}$.

15. $.2 : 133\frac{1}{3} = \frac{1}{5} \div \frac{400}{3} = \frac{3}{400}$ of $\frac{1}{5} = \frac{3}{2000}$.

16. $.42\frac{6}{7} : .8 = 4.2\frac{6}{7} : 8 = 4\frac{2}{7} : 8 = 30 : 56 = \frac{15}{28}$.

17. $.00\frac{8}{9} : .11\frac{1}{9} = \frac{8}{9} : 11\frac{1}{9} = \frac{8}{9} \div \frac{100}{9} = 8 \div 100 = \frac{2}{25}$.

18. $\frac{2}{3} : 6.6\frac{2}{3} = \frac{2}{3} : 6\frac{2}{3} = 2 : 20 = \frac{1}{10}$.

19. $1 : \frac{3}{2} = 2 : 3 = 2.00 \div 3 = .66\frac{2}{3}$.

20. $50 : 11\frac{1}{9} = 450 \div 100 = 4.50$.

21. $.375 : \frac{2}{3} = 1.125 \div 2 = 1.12\frac{1}{2} \div 2 = .56\frac{1}{4}$.

22. $6.2\frac{1}{2} : 9\frac{1}{11} = 6.25 \div 9\frac{1}{11} = 68.75 \div 100 = .6875 = .68\frac{3}{4}$.

26. 1 yd. $= \frac{1}{5}$ of 5 yd. $= .20$ of 5 yd.
$\therefore$ 4 yd. $= .80$ of 5 yd. $\therefore$ 80 $=$ the number of hundredths.

27. 1 ft. $= \frac{1}{6}$ of 6 ft.
$\therefore$ $3\frac{1}{3}$ ft. $= \frac{10}{3} \times \frac{1}{6}$ of 6 ft. $= \frac{5}{9}$ of 6 ft. $= .55\frac{5}{9}$ of 6 ft. $\therefore$ $55\frac{5}{9} =$ the number of hundredths.

28. $66\frac{2}{3}$ lb. $= \dfrac{66\frac{2}{3}}{83\frac{1}{3}}$ of $83\frac{1}{3}$ lb. $= \frac{4}{5}$ of $83\frac{1}{3}$ lb. $= .80$ of $83\frac{1}{3}$ lb.
$\therefore$ 80 $=$ the number of hundredths.

29. The ratio of the weight of granite to water $=$ the ratio of 173.75 lb. to 62.5 lb., or $173.75 : 62.5 = 17375 : 6250 = 2.78$.

30. The ratio of A's wages to B's $= 1.87\frac{1}{2} : 1.37\frac{1}{2} = 1\frac{7}{8} : 1\frac{3}{8} = 15 : 11 = 1\frac{4}{11}$.

31. $\$1 = \frac{1}{8}$ of his earnings per week.

$\therefore\ \$5\frac{3}{4} = \$\frac{23}{4} = \frac{23}{4}$ of $\frac{1}{8} = \frac{23}{32}$ of his earnings = the part he spends. Whence, $\frac{32}{32} - \frac{23}{32} = \frac{9}{32}$ = the part he saves.

33. The ratio of the length to the width $= 16\frac{2}{3} : 12\frac{1}{2} = 100 \div 75 = 1\frac{1}{3}$.
The ratio of the width to the length $= 12\frac{1}{2} : 16\frac{2}{3} = 75 \div 100 = \frac{3}{4}$.

36. $4031.25 : (21.5 \times 62.5) = 403125 : 215 \times 625 = \frac{403125}{215 \times 625} = 3$ = the number of cubic feet of platinum.

Exercise 75, Page 130.

9. $375.0875 + .035 - .10028 = 375.1225 - .10028 = 375.02222 = 375.022$.

10. $.00854 \times 375.358 = 3.20555732 = 3.205557$.

11. $1 \div 375 = 1.000 \div 375 = .0026+ = .003$.

13. 3748 ft = 3.748 thousand feet.

$\therefore\ 3.748 \times \$24 = \$89.95$ = the required cost.

14. 8750 = 8.75 thousand.

$\therefore\ 8.75 \times 1 = 8.75$ = the number of barrels required.

15. 1764 sq. yd. = 17.64 hundred square yard.

$\therefore\ 17.64 \times 1.5 = 26.46$ = the number of bushels required.

17. .66 of 100 lb. = 66 lb. = the amount of fat.
.267 of 100 lb. = 26.7 lb. = the amount of sugar, etc.

20. .42 of 60 = 25.2 = the number of pounds of finest flour.
.18 of 60 = 10.8 = the number of pounds of seconds.
.09 of 60 = 5.4 = the number of pounds of biscuit flour.

21. 2000 lb. : 7.2 × 62.5 lb. $= 2000 : 450 = 40 : 9 = 4\frac{4}{9}$ = the number of cubic feet of cast iron in 2000 lb.

22. 31.5 × 231 cu. in. : 2150.42 cu. in. $= 7276.50 \div 2150.42 = 3.38$ = the number of bushels in a barrel.

24. $64.3 : 62.5 = 643 : 625 = 1.028 = 1.03$ = the ratio of the weight of sea water to that of fresh water.

26. 1648 sq. ft. = 16.48 hundred square feet.

$\therefore\ 16.48 \times \$5.46 = \$89.98$ = the cost of the tin required.

27. $\$4 + 11 \times \$0.04 = \$4.44$ = the cost of the laths and nails for 70 sq. yd.

$\therefore\ 11 \times \$4.44 = \$48.84$ = the cost of the laths and nails for 770 sq. yd.

29. 2.5 lb. = the weight of 1.20032 qt. of water (U. S. Standard).

$\therefore$ 2.5 lb. $\div$ 1.20032 = 250000 lb. $\div$ 120032 = 2.08277 lb. = 2.0828 lb. = the weight of 1 qt. of water (U. S. Standard).

30. .1715 of the population in 1890 = 74518.

Whence, 74518 $\div$ .1715 = 745180000 $\div$ 1715 = 434507 = the population in 1890.

$\therefore$ 434507 + 74518 = 509025 = the population in 1900.

31. 2240 lb. = 22.4 hundred pounds.

$\therefore$ 22.4 × \$0.28 = \$6.27 = the cost.

32. 24 × 13.55 yr. = 325.20 yr. = the sum of the ages of the 24 girls.

6 × 14.62 yr. = 87.72 yr. = the sum of the ages of the 6 girls.

$\therefore$ 325.20 yr. + 87.72 yr. = 412.92 yr. = the sum of the ages of the 30 girls.

Whence, $\frac{1}{30}$ of 412.92 yr. = 13.764 yr. = the average age of all the girls.

33. $.006 \div .\cancel{02} \times .\cancel{02} \div .006 = 1.$

$.002 \times 60 \div .12 = 1.$

$\frac{1}{2} \times \frac{1}{3} \div \frac{1}{4} = \frac{2}{3}$; $\frac{1}{4} \div \frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$; $\frac{1}{2}$ of $1\frac{1}{2} = \frac{3}{4}$.

$$\therefore \frac{.006 \div .02 \times .02 \div .006 + .002 \times 60 \div .12}{\frac{1}{2} \times \frac{1}{3} \div \frac{1}{4} + \frac{1}{4} \div \frac{1}{2} \times \frac{1}{3} - \frac{1}{6} + \frac{1}{2} \text{ of } 1\frac{1}{2}} = \frac{1+1}{\frac{2}{3}+\frac{1}{6}-\frac{1}{6}+\frac{3}{4}} = \frac{2}{\frac{17}{12}} = 1\tfrac{7}{17}.$$

Exercise 77, Page 137.

1. WOODBURY, N.J., June 15, 1901.

MR. JAMES WILSON,

To G. G. GREEN, *Dr.*

TERMS CASH.

36 yd. Muslin	\$0.09	3	24		
1 doz. Men's Linen Handkerchiefs	1.80	1	80		
2 pr. Gloves	.75	1	50		
4 pr. Socks	.25	1	00		
10 yd. Fancy Ribbons	.12	1	20		
2 Silk Waists	6.00	12	00		
				20	74

Received payment,

G. G. GREEN.

2. COLUMBIA, PA., April 1, 1902.

MR. A. T. HIGH,

In account with M. J. RHODES.

DR.					
2 M. ft. Pine Boards	$32.00	64	00		
3 " " Scantling	20.00	60	00		
1½ " " Boards	24.00	36	00		
3 " Shingles	17.50	52	50		
CR.				212	50
2 C. Rough Locust Posts	8.00	16	00		
6 " Chestnut Rails	6.00	36	00		
				52	00
Balance,				160	50

3. (Place and Date.)

(Your Name.)

To GEORGE S. LEASE, *Dr.*

14 days hauling	$1.00	14	00		
4 days threshing grain	1.50	6	00		
8 days making fence	1.25	10	00		
				30	00

4. PHILADELPHIA, June 1, 1904.

MR. HENRY JONES,

To THOMAS C. FLUKE & CO., *Dr.*

2 qt. Cranberries	$0.15		30		
4 lb. French Prunes	.25	1	00		
4 doz. Fla. Oranges	.50	2	00		
4 glasses Guava Jelly	.35	1	40		
½ doz. bottles Grape Juice	2.75	1	38		
3 lb. White Grapes	.30		90		
10 lb. Cut Loaf Sugar	.07		70		
3 doz. Royalty Corn	1.50	4	50		
8 lb. Rice	.10		80		
				12	98

5. **Baltimore, Md.**, May 18, 1900.

Mr. Lewis Harman,

To **Hays & Co.**, *Dr.*

Jan.	2	25 bu. Wheat	$0.65	16	25		
"	2	40 bu. Oats	.30	12	00		
Mar.	2	2 bbl. Fancy Flour	4.45	8	90		
"	2	2 bu. Clover Seed	5.00	10	00		
"	2	60 bu. Oats	.31	18	60		
		Received payment, May 21, 1900.				65	75

Hays & Co.

6. **Plainfield**, N.J., Sept. 1, 1900.

Mr. R. L. Wilson,

In account with J. H. **Raub.**

Dr.					
$\frac{1}{4}$ lb. Nutmegs	$0.55		14		
6 packages Cornstarch	0.05		30		
2 gal. Mott's Pure Apple Vinegar	0.13		26		
6 lb. "Our Choice" Codfish	0.07		42		
2 bottles Domestic Comb Honey	0.25		50		
4 lb. Rio Coffee	0.22		88		
100 lb. Granulated Sugar	0.05	5	00		
				7	50
Cr.					
18 lb. Butter	0.18	3	24		
20 doz. Eggs	0.22	4	40		
				7	64
Balance due R. L. Wilson					14

Exercise 89, Page 167.

1. $1^{cm} = 0.3937$ in. [§ 225].

$\therefore$ 1 in. : 0.3937 in., or $1.000000 \div 0.3937$, or $2.54 =$ the number required.

2. $1^{Dm} = 393.7$ in. [§ 225], and 1 rd. $= 198$ in.

$\therefore$ 393.7 in. : 198 in., or $1.99 =$ the number required.

3. $1^{qcm} = 0.155$ sq. in. [§ 228].

∴ 1 sq. in. : 0.155 sq. in., or $1.00000 \div 0.155$, or $6.45 =$ the number required.

4. $100^{qm} = 1^{a} = 119.6$ sq. yd. [§ 228].

∴ $10^{qm} = 11.96$ sq. yd.

5. $1^{Ha} = 2.471$ A. [§ 228].

∴ $25^{Ha} = 25 \times 2.471$ A., or 61.775 A.

PART 2. 1 A. = 4840 sq. yd., and $1^{a} = 119.6$ sq. yd.

∴ 4840 sq. yd. : 119.6 sq. yd, or $40.47 =$ the number required.

6. $1^{cm} = .3937$ in.

∴ $1^{ccm} = (.3937)^3$ cu. in., or .061023377953 cu. in.

Then, 1 cu. in. : .061023377953 cu. in., or $1.000000000000 \div .061023377953$, or $16.39 =$ the number required.

7. $1^{s} = 35.315$ cu. ft. [§ 229], and 1 cu. yd. = 27 cu. ft.

∴ 35.315 cu. ft. : 27 cu. ft., or $1.31 =$ the number required.

8. $25^{kg} = 25 \times 2.2046$ lb., or 55.115 lb. [§ 226].

PART 2. $1^{g} = 15.432$ gr. [§ 226], and 1 lb. Troy = 5760 gr.

∴ 5760 gr. : 15.432 gr., or $373.25 =$ the number required.

9. $20^{Hl} = 20 \times 2.8375$ bu., or 56.75 bu. [§ 227].

PART 2. $20^{Hl} = 200^{Dl} = 200 \times 2.6417$ gal. = 528.34 gal.

10. $1^{l} = 0.908$ qt. (dry).

∴ 4 qt. : 0.908 qt., or $4.00000 \div .908$, or $4.41 =$ the required number.

PART 2. $1^{l} = 1.0567$ qt. (liquid).

∴ 4 qt. : 1.0567 qt., or $4.000000 \div 1.0567$, or $3.79 =$ the required number.

11. 1^{ccm} of water weighs 1^{g} [§ 219].

∴ 1000^{ccm}, or 1^{cdm}, or 1^{l} of water weighs 1000^{g}, or 1^{Kg}.

And, 1000^{cdm}, or 1^{cbm} of water weighs 1000^{kg}, or 1^{MT}.

12. $1^{Kg} =$ the weight of 1^{l} of water.

∴ $1.03^{Kg} =$ the weight of 1^{l} of milk, 1.03 times as heavy as water.

13. $2^{g} =$ the weight of 2^{ccm} of water.

10.47×2^{g}, or $20.94^{g} =$ the weight of 2^{ccm} of silver.

14. $\frac{45 \times 20.5}{100}$, or $9.225 =$ the required number [§ 228].

15. $1^{l} = 1^{cdm} = 1000^{ccm}$.

∴ $5^{cl} = .05$ of 1000^{ccm}, or 50^{ccm}.

16. 1^{l} of water weighs 1000^{g} [Exercise 89, prob. 11].

∴ 1^{ml} of water weighs .001 of 1000^{g}, or 1^{g}.

17. $4 \times 2.5 \times 1.75 \times 1000$, or $17500 =$ the number of cubic decimeters in the bin.
$1^{l} = 1^{cdm}$; then $1^{Hl} = 100^{cdm}$.
$\therefore 175000 \div 100$, or $175 =$ the number required.

18. $1^{g} =$ the weight of 1^{ccm} of water.
$\therefore 1^{Kg} =$ the weight of 1^{cdm} of water.
And, $2.5^{Kg} =$ the weight of 2.5^{cdm} of water or, 2.5^{l}, since $1^{l} = 1^{cdm}$ [§ 220].

19. 45×42, or $1890 =$ the number of ares.
$\therefore 18.9 =$ the number of hectares.
Then 18.9×1.4^{Hl}, or 26.46^{Hl}, or $26^{Hl}\ 4^{Dl}\ 6^{l} =$ the required amount.

20. $15 \times 1.25 \times 1.25$, or $23.4375 =$ the required number [§ 229].

21. 1^{l} of water weighs 1000^{g}.
$\therefore 1^{cl}$ of water weighs 10^{g}, or 10000^{mg}.
Then, 1^{cl} of alcohol weighs $.792 \times 10000^{mg}$, or 7920^{mg}.

22. 50.5×24, or $1212 =$ the number of ares in the field [§ 228].
$1212^{a} = 12.12^{Ha}$.
Then 12.12×15^{Hl}, or $181.8^{Hl} =$ the yield of wheat.
181.8×55^{Kg}, or 9999^{Kg}, or $9.999^{MT} =$ the yield of flour.

23. 1^{ccm} of water weighs 1^{g}.
$\therefore 1^{ccm}$ of olive oil weighs $.915^{g}$.
$\therefore 36.600^{g} : .915^{g}$, or $40 =$ the number required.

24. 36×36, or $1296 =$ the number of ares in the piece.
$1296^{a} = 12.96^{Ha}$.
$12.96 \times \$200$, or $\$2592 =$ the cost.
$1296 \div 72$, or $18 =$ the number of lots sold.
$18 \times \$350$, or $\$6300 =$ the selling price.
And, $\$6300 - \$2592$, or $\$3708 =$ the gain.

25. $1^{m} = 10^{dm}$, $8^{cm} = .8^{dm}$, $5^{cm} = .5^{dm}$.
$10 \times .8 \times .5$, or $4 =$ the number of cubic decimeters in the bar.
4^{cdm} of water weighs 4^{Kg}.
4^{cdm} of steel weighs 7.81×4^{Kg}, or 31.24^{Kg}.

26. $4.5 \times 2.4 \times 4$, or $43.2 =$ the number of cubic meters in the tank.
$1^{cdm} = 1^{l}$; then, $1^{cbm} = 1^{Kl}$.
$\therefore 43.2^{cbm} = 43.2^{Kl}$.
43.2^{cbm} of water weighs 43.2^{MT} since 1^{cbm} of water weighs 1^{MT}.
$\therefore 43.2^{Kl}$ weighs 43.2^{MT}.

27. 26.75^{Kg} = the weight of the vessel and water.
$\underline{4.8^{\ Kg}}$ = the weight of the vessel.
∴ 21.95^{Kg} = the weight of the water.
21.95^{Kg} = the weight of 21.95^{l} of water.
∴ 21.95 = the required number of liters.

28. A liter jar holds 1^{Kg}, or 1000^{g}, of water.
∴ A liter jar holds $.792 \times 1000^{g}$, or 792^{g} of alcohol.
Then, $700^{g} + 792^{g}$, or 1492^{g} = the weight of the jar when filled.

Exercise 90, Page 170.

1. $\frac{3}{4}$ yd. = $2\frac{1}{4}$ ft.
10 ft. : $2\frac{1}{4}$ ft. = $10 \div \frac{9}{4}$, or $4\frac{4}{9}$, the number of strips needed.
Then, 5 = the number of strips that must be bought.

2. 16 ft. : $2\frac{1}{4}$ ft., or $16 \div \frac{9}{4} = 7\frac{1}{9}$, the number of strips needed.
Then, 8 strips must be bought.
8×18 ft., or 8×6 yd., or 48 yd. = the amount of carpet to be bought.

3. 14 ft. : $2\frac{1}{4}$ ft., or $14 \div \frac{9}{4} = 6\frac{2}{9}$, the number of strips needed.
Then, 7 strips must be bought.
16 ft. + $\frac{1}{8}$ yd., or $5\frac{1}{3}$ yd. + $\frac{1}{8}$ yd., or $5\frac{11}{24}$ yd. = the length of each strip.
$7 \times 5\frac{11}{24}$ yd., or $38\frac{5}{24}$ yd. = the amount of carpet bought.
$38\frac{5}{24} \times \$1.50$, or $57.31 = the cost.

4. 22 ft. : $2\frac{1}{4}$ ft., or $22 \div \frac{9}{4}$, = $9\frac{7}{9}$, the number of strips required.
Then, 10 strips must be bought.
10×15 ft. + $2\frac{1}{2}$ yd., or 10×5 yd. + $2\frac{1}{2}$ yd., or $52\frac{1}{2}$ yd. = the amount required.

5. $12 \times 3\frac{1}{2}$, or 42 = the number of square feet in the floor of the hall.
42 sq. ft. = $4\frac{2}{3}$ sq. yd.
∴ $4\frac{2}{3} \times \$0.40$, or $\$1.86\frac{2}{3}$, or $1.87 = the required cost.

6. $2 \times \frac{3}{8}$ yd., or $\frac{3}{4}$ yd. = the amount to be deducted for border.
16 ft. = $5\frac{1}{3}$ yd.
$5\frac{1}{3}$ yd. − $\frac{3}{4}$ yd., or $4\frac{7}{12}$ yd. = the width of the room carpeted.
$4\frac{7}{12}$ yd. : $\frac{3}{4}$ yd. = $6\frac{1}{9}$.
∴ 7 = the number of strips required.
20 ft. = $6\frac{2}{3}$ yd.
$6\frac{2}{3}$ yd. − $\frac{3}{4}$ yd., or $5\frac{11}{12}$ yd. = the length of each strip.
∴ $7 \times 5\frac{11}{12}$ yd., or $41\frac{5}{12}$ yd. = the amount of carpet required.
2×20 ft. + 2×16 ft., or 72 ft., or 24 yd. = the distance around the room.
∴ $41\frac{5}{12} \times \$0.90 + 24 \times \$1.20$, or $66.08 = the required cost.

7. ¾ yd. = 2¼ ft.

∴ 2 × 2¼ ft., or 4½ ft. = the amount to be deducted for border.

∴ 16 ft. − 4½ ft., or 11½ ft. = the width to be carpeted.

¾ yd., or 2¼ ft. = the width of the carpet.

11½ : 2¼ = 5⅑.

∴ 6 = the number of strips required.

18 ft. − 4½ ft., or 13½ ft. = the length of each strip.

∴ 6 × 13½ ft., or 81 ft., or 27 yd. = the amount of carpet required.

2 × 18 ft. + 2 × 16 ft., or 68 ft., or 22⅔ yd. = the amount of border required.

Exercise 91, Page 171.

2. 2 × 18 ft. + 2 × 14 ft., or 64 ft. = the distance around the room.

∴ 9 × 64, or 576 = the number of square feet in the surface of the walls.

(7½ × 4) + 4 × (6 × 4), or 126 = the number of square feet to be deducted.

∴ 576 − 126, or 450 = the number of square feet to be papered.

24 × 1½, or 36 = the number of square feet in 1 roll.

450 : 36 = 12½.

∴ 13 = the number of rolls required.

64 ft., or 21⅓ yd. = the distance around the room.

∴ 13 × $0.35 + 21⅓ × $0.20, or $8.82 = the required cost.

3. 2 × 20 ft. + 2 × 16 ft., or 72 ft. = the distance around the room.

∴ 9 × 72, or 648 = the number of square feet in the surface of the walls.

20 × 16, or 320 = the number of square feet in the surface of the ceiling.

648 : 36 = 18, and 320 : 36 = $8\frac{8}{19}$.

∴ 18 + 9, or 27 = the number of rolls required to cover the whole surface.

(2 × ½) + (4 × ½), or 3 = the number of rolls to be deducted.

∴ 27 − 3, or 24 = the required number of rolls.

72 ft., or 24 yd. = the distance around the room.

∴ 24 × $0.22 + 24 × $0.15, or $8.88 = the required cost.

4. 18 × 16, or 288 = the number of square feet in the ceiling.

2 × 18 ft. + 2 × 16 ft., or 68 ft. = the distance around the room.

68 × 9¼, or 629 = the number of square feet in the walls.

$2 \times (7\frac{1}{2} \times 4) + 4 \times (6 \times 4)$, or 156 = the number of square feet to be deducted.

629 − 156, or 473 = the number of square feet of wall to be papered.

288 : 36 = 8, and 473 : 36 = $13\frac{5}{36}$.

∴ 8 + 14, or 22 = the number of rolls required.

68 ft., or $22\frac{2}{3}$ yd. = the distance around the room.

∴ 22 × $0.18 + $22\frac{2}{3}$ × $0.10, or $6.23 = the required cost.

Exercise 92, Page 173.

1. 20 × 18, or 360 = the number of square feet in the surface.

360 sq. ft. = 40 sq. yd.

40 sq. yd. : 2 sq. yd., or 20 = the required number of pounds of lead.

2. 24 × 22, or 528 = the number of square feet in the floor.

528 sq. ft. = $58\frac{2}{3}$ sq. yd.

$58\frac{2}{3}$ sq. yd. : $3\frac{1}{2}$ sq. yd. = $16\frac{16}{21}$.

∴ $16\frac{16}{21}$ × 1 bu., or $16\frac{16}{21}$ bu. = the amount of cement required.

And $16\frac{16}{21}$ × 2, or $33\frac{11}{21}$ bu. = the amount of sand required.

3. 2 × 20 ft. + 2 × 18 ft., or 76 ft. = the distance around the room.

∴ 76 × 10, or 760 = the number of square feet in the entire wall.

20 × 18, or 360 = the number of square feet in the ceiling.

∴ 760 + 360, or 1120 = the number of square feet in the entire surface.

$\frac{1}{2}$ of $[(7\frac{1}{2} \times 4) + 3 \times (6 \times 4)]$, or 51 = the number of square feet to be deducted.

∴ 1120 sq. ft. − 51 sq. ft., or 1069 sq. ft., or $118\frac{7}{9}$ sq. yd. = the surface to be plastered.

∴ 119 × $0.15, or $17.85 = the required cost.

4. 2 × 20 rd. + 2 × 16 rd., or 72 rd., or 396 yd. = the length of the fence.

6 ft. or 2 yd. = the height of the fence.

∴ 2 × (396 × 2), or 1584 = the number of square yards in the surface of both sides.

1584 : 100, or 15.84 = the number of gallons of paint required.

5. 2 × 18 ft. + 2 × 16 ft., or 68 ft. = the distance around the room.

∴ 68 × 10 or 680 = the number of square feet in the wall.

18 × 16 or 288 = the number of square feet in the ceiling.

∴ 680 + 288, or 968 = the number of square feet in the whole area.

$2 \times (7\frac{1}{2} \times 4) + 2 \times (6 \times 4)$, or $108 =$ the number of square feet in the doors and windows.

$\therefore \frac{1}{2}$ of 108, or $54 =$ the number of square feet to be deducted.

$\therefore$ 968 sq. ft. – 54 sq. ft., or 914 sq. ft., or 102 sq. yd. = the surface to be plastered.

102 sq. yd. : 70 sq. yd. $= 1\frac{16}{35}$.

$\therefore 1\frac{16}{35} \times 1000$ or $1457\frac{1}{7} =$ the number of laths needed.

$\therefore 1458 =$ the number used.

$1\frac{16}{35} \times 11$ lb., or $16\frac{1}{35}$ lb. = the amount of nails used.

102 sq. yd. : 100 sq. yd. = 1.02.

$\therefore 1.02 \times 8$ bu., or 8.16 bu. = the amount of lime used.

1.02×16 bu., or 16.32 bu. = the amount of sand used.

And 1.02×1 bu., or 1.02 bu. = the amount of hair used.

Exercise 93, Page 174.

1. $13\frac{1}{3}$ bd. ft.

2. 16.

3. $10 \times \frac{16 \times 9}{12}$, or $120 =$ the number of board feet.

120 bd. ft. = .12 M. bd. ft.

$\therefore .12 \times \$30$, or $\$3.60 =$ the required cost.

4. $\frac{6 \times 10 \times 24}{12}$, or $120 =$ the number of board feet in the beam.

5. $1\frac{1}{2}$ ft. = 18 in.

$\frac{10 \times 18 \times 50}{12}$, or $750 =$ the number of board feet in the stick.

6. 6 ft. = 72 in., and 8 ft. = 96 in.

$\frac{72 \times 96 \times 16}{12}$, or $9216 =$ the number of board feet in the pile.

9216 = 9.216 M.

$\therefore 9.216 \times \$24$, or $\$221.18 =$ the value of the pile.

7. $60 \times \frac{3\frac{1}{2} \times 16}{12}$, or $280 =$ the number of board feet.

280 = .28 M.

$\therefore .28 \times \$24$, or $\$6.72 =$ the required cost.

8. 2 boards must be bought for the ends.

6 boards must be bought for the sides.

4 boards must be bought for the bottom.

∴ 12 × 14, or 168 = the number of feet of boards to be bought.

And, .168 × $14, or $2.35 = the cost.

9. $10 \times \frac{2 \times 3 \times 18}{12}$, or 90 = the number of board feet of scantling.

$4 \times \frac{1\frac{1}{2} \times 6 \times 14}{12}$, or 42 = the number of board feet of planks.

$6 \times \frac{4 \times 4 \times 20}{12}$, or 160 = the number of board feet of beams.

$40 \times \frac{8 \times 16}{12}$, or $426\frac{2}{3}$ = the number of board feet of boards.

90 = .09 M.; 42 = .042 M.; 160 = .16 M.; $426\frac{2}{3}$ = .$426\frac{2}{3}$ M.

∴ .09 × $18 + .042 × $$27\frac{1}{2}$ + .16 × $35 + .$426\frac{2}{3}$ × $35, or $23.31 = the required cost.

10. 24 × 22, or 528 = the number of square feet in the floor.

3 in. = $\frac{1}{4}$ ft.

16 × $\frac{1}{4}$, or 4 = the number of square feet in 1 board.

∴ 528 sq. ft. : 4 sq. ft., or 132 = the number of boards required.

11. 4 × 6, or 24 = the number of square inches in exposed surface of 1 shingle.

24 sq. in. = $\frac{1}{6}$ sq. ft.

∴ 100 sq. ft. : $\frac{1}{6}$ sq. ft., or 600 = the required number of shingles.

12. 6 × 6, or 36 = the number of square inches in exposed surface of 1 shingle.

36 sq. in. = $\frac{1}{4}$ sq. ft.

∴ 1000 × $\frac{1}{4}$, or 250 = the number of square feet 1000 shingles will cover.

13. 4 × $4\frac{1}{2}$, or 18 = the number of square inches in exposed surface of 1 shingle.

18 sq. in. = $\frac{1}{8}$ sq. ft.

∴ 250 × $\frac{1}{8}$, or $31\frac{1}{4}$ = the number of square feet 1 bale will cover.

14. 4 × 5, or 20 = the number of square inches in exposed surface of 1 shingle.

20 sq. in. = $\frac{5}{36}$ sq. ft.

∴ 100 sq. ft. : $\frac{5}{36}$ sq. ft., or 720 = the required number of shingles.

15. 2 × 38 × 14, or 1064 = the number of square feet in the roof.

2 × 38 ft., or 76 ft. = the length of the first course.

5 in., or $\frac{5}{12}$ ft. = the width of the first course.

∴ 76 × $\frac{5}{12}$, or $31\frac{2}{3}$ = the number of square feet in the first course.

∴ 1064 + $31\frac{2}{3}$, or $1095\frac{2}{3}$ = the number of square feet of shingles required.

720 = the number of shingles to 100 ft.

$1095\frac{2}{3}$: 100 = $10.95\frac{2}{3}$.

∴ $10.95\frac{2}{3}$ × 720, or 7889 = the number of shingles required.

Exercise 94, Page 177.

2. 33 × 4 × 3, or 396 = the number of cubic feet in the pile.

∴ 396 cu. ft. : $24\frac{3}{4}$ cu. ft., or 16 = the required number of perch.

3. 40 × 4 × $1\frac{1}{2}$, or 240 = the number of cubic feet in the wall.

240 cu. ft. : $24\frac{3}{4}$ cu. ft., or $9\frac{23}{33}$ = the number of perch in the wall.

∴ $\frac{8}{9}$ of $9\frac{23}{33}$, or $8\frac{184}{297}$ = the number of perch of stone required.

4. 2 × 40 ft. + 2 × 36 ft., or 152 ft. = the distance around the cellar.

∴ 152 × 10 × $1\frac{1}{2}$, or 2280 = the number of cubic feet in the wall.

2280 cu. ft. : $24\frac{3}{4}$ cu. ft., or $92\frac{12}{99}$ = the number of perch in the wall.

∴ $92\frac{12}{99}$ × $0.75, or $69.09 = the required charge.

5. 24 cu. ft. : 22 cu. ft., or $1\frac{1}{11}$ = the required number of perch.

6. 36 ft. − $\frac{3}{4}$ ft. = $35\frac{1}{4}$ ft., and 30 ft. − $\frac{3}{4}$ ft. = $29\frac{1}{4}$ ft.

∴ 2 × $35\frac{1}{4}$ ft. + 2 × $29\frac{1}{4}$ ft., or 129 ft. = the length of the wall.

129 × 24, or 3096 = the number of square feet in the entire surface of the wall.

4 × ($7\frac{1}{2}$ × 4) + 24 × (6 × 4), or 696 = the number of square feet to be deducted.

∴ 3096 − 696, or 2400 = the number of square feet to be built.

2400 × 7, or 33600 = the number of bricks required.

33600 = 33.6 M.

∴ 33.6 × $9, or $302.40 = the required cost.

7. $49\frac{1}{2}$ × 33 × 8, or 13068 = the number of cubic feet of earth.

13068 cu. ft. = 484 cu. yd., or loads.

2 × $49\frac{1}{2}$ ft. + 2 × 33 ft., or 165 ft. = the length of the wall.

165 × 10 × $1\frac{1}{2}$, or 2475 = the number of cubic feet in the wall.

2475 cu. ft. : $24\frac{3}{4}$ cu. ft., or 100 = the number of perch of stone required.

∴ 484 × $0.20 + 100 × $1.20, or $216.80 = the required cost.

8. $16\frac{1}{2}$ × $1\frac{1}{2}$ × 1, or $24\frac{3}{4}$ = the number of cubic feet in 1 perch.

Exercise 95, Page 178.

6. Radius = $\frac{1}{2}$ of (176 ft. ÷ $\frac{22}{7}$), or 28 ft.

7. Radius = $\frac{1}{2}$ of (88 ft. ÷ $\frac{22}{7}$), or 14 ft.
The number of square feet = ($\frac{1}{2}$ of 14) × 88, or 616.

8. Circumference = $\frac{22}{7}$ × 4 ft., or $12\frac{4}{7}$ ft.
∴ 5280 ft. : $12\frac{4}{7}$ ft., or 420 = the number required.

9. Circumference = $\frac{22}{7}$ × 18 in., or $56\frac{4}{7}$ in.
∴ $56\frac{4}{7}$ in. = the required distance.

10. 4 in. = the radius of the face of the clock.
Circumference = $\frac{22}{7}$ × (2 × 4 in.), or $25\frac{1}{7}$ in.
In 15 min. the minute hand moves $\frac{1}{4}$ the whole distance around.
∴ $\frac{1}{4}$ of $25\frac{1}{7}$ in., or $6\frac{2}{7}$ in. = the required distance.

11. 1 mi. = 1760 yd.
Radius = $\frac{1}{2}$ of (1760 yd. ÷ $\frac{22}{7}$), or 280 yd.

12. 1 geographic mile = 6086 ft. = $\frac{6086}{5280}$ of a statute mile.
∴ 15 × 60 × $\frac{6086}{5280}$ statute miles, or $1037\frac{17}{44}$ statute miles = the required length.

13. 18 in. : $\frac{1}{2}$ in., or 36 = the number of wads in the length.
$8\frac{1}{4}$ in. : $\frac{1}{2}$ in., or 16 = the number of wads in the width.
∴ 36 × 16, or 576 = the required number.

14. $\frac{22}{7} \times 4^2$, or $50\frac{2}{7}$ = the number of square feet in the surface.
∴ $50\frac{2}{7}$ × $1, or $50.29 = the required cost.

Exercise 96, Page 180.

3. $\frac{22}{7}$ × 2 × $1\frac{1}{2}$ in., or $9\frac{3}{7}$ in. = the circumference of the base.
∴ $9\frac{3}{7}$ × 3, or $28\frac{2}{7}$ = the number of square inches in the lateral surface.

4. $9\frac{3}{7}$ in. = the circumference of the base.
$\frac{1}{2}$ of $1\frac{1}{2}$ × $9\frac{3}{7}$ = the number of square inches in the base.
∴ 3 × ($\frac{1}{2}$ of $1\frac{1}{2}$ × $9\frac{3}{7}$), or $21\frac{3}{14}$ = the number of cubic inches in the cup.

5. 2 × $2\frac{1}{2}$ × $\frac{22}{7}$ = the number of feet in the circumference of the base.
∴ 8 × (2 × $2\frac{1}{2}$ × $\frac{22}{7}$), or $125\frac{5}{7}$ = the number of square feet in the lateral surface.
$2 \times (2\frac{1}{2})^2 \times \frac{22}{7}$, or $39\frac{2}{7}$ = the number of square feet in the area of the bases.
∴ $125\frac{5}{7}$ sq. ft. + $39\frac{2}{7}$ sq. ft., or 165 sq. ft. = the entire surface.

6. $\frac{22}{7} \times 2 \times 14$ in., or 88 in. or $7\frac{1}{3}$ ft. = the circumference of the base.

∴ $880 \div 7\frac{1}{3}$, or 120 = the number of feet in the altitude.

7. 40 bbl. = 1260 gal.

$(1260 \times 231) \div 1728$, or 168.4375 = the number of cubic feet in the cistern.

$(\frac{1}{2} \text{ of } 6)^2 \times \frac{22}{7}$, or $\frac{198}{7}$ = the number of square feet in the area of the base.

∴ $168.4375 \div \frac{198}{7}$, or 5.95 = the number of feet in the depth.

8. $\frac{22}{7} \times 2^2$ = the number of square centimeters in the base.

∴ $24 \times \frac{22}{7} \times 2^2$, or $301\frac{5}{7}$ = number of cubic centimeters in the flask.

9. $(\frac{22}{7} \times 10^2) \times 16$, or $5028\frac{4}{7}$ = the number of cubic feet in the tank.

$5028\frac{4}{7}$ cu. ft. = 8689371.429 cu. in.

8689371.429 cu. in. : 231 cu. in., or 37616.33 = the number of gallons.

10. 2 mi. = 126720 in.

∴ $\frac{22}{7} \times (\frac{9}{2})^2 \times 126720$, or $8064822\frac{6}{7}$ = the number of cubic inches of water which flows through in 1 hr.

∴ $6 \times 8064822\frac{6}{7}$ cu. in., or $48388937\frac{1}{7}$ cu. in., or 209476 gal. = the amount flowing through in 6 hr.

Exercise 97, Page 181.

1. 1 link = 7.92 in.

∴ 25 links = 25 × 7.92 in., or 198 in. = 1 rd.

2. 100 × 80, or 8000 = the number of square feet in the lot.

36 × 24, or 864 = the number of square feet for the house.

∴ 8000 − 864, or 7136 = the number of square feet for the yard.

3. $\frac{1}{2}$ mi. = 2640 ft.

2640 × 32, or 84480 = the number of square feet for the road.

84480 sq. ft. = $310\frac{10}{33}$ sq. rd. = $1\frac{31}{33}$ A.

4. 1728 cu. in. : 231 cu. in., or 7.48 = the number gallons in 1 cu. ft.

5. 2 × 4 in. + 2 × 2 in., or 12 in. = the distance around the end.

∴ 8 × 12, or 96 = the number of square inches in the faces.

2 × (4 × 2), or 16 = the number of square inches in the ends.

∴ 96 + 16, or 112 = the number of square inches required.

6. 4 ft. $6\frac{1}{2}$ in. = $54\frac{1}{2}$ in.

$54\frac{1}{2}$ in. : 2 in. = $27\frac{1}{4}$.

∴ 27 = the number of blocks on one row.

2 ft. 3 in. = 27 in.
27 in. : 2 in. = $13\frac{1}{2}$.
$\therefore$ 13 = the number of rows of blocks.
$\therefore$ 13 × 27, or 351 = the number of blocks which may be placed on the table.

7. 2 × 2, or 4 = the number of square inches each block covers.
$\therefore$ 351 × 4 sq. in., or 1404 sq. in. = the surface covered by the blocks.
$54\frac{1}{2}$ × 27, or $1471\frac{1}{2}$ = the number of square inches in the whole surface.
$\therefore$ $1471\frac{1}{2} - 1404$, or $67\frac{1}{2}$ = the number of square inches uncovered.

8. 4 × 4, or 16 = the number of square inches in each face.
$\therefore$ 6 × 16, or 96 = the number of square inches required.

9. 3 × 220 × 8 × 144 = the number of square inches in the pavement.
4 × 8 = the number of square inches in 1 brick.

$$\therefore \frac{3 \times \overset{55}{\cancel{220}} \times \cancel{8} \times 144}{\cancel{4} \times \cancel{8}}, \text{ or } 23760 = \text{the required number of bricks.}$$

10. 30 − 6, or 24 = the number of working days.
24 × $9\frac{1}{2}$, or 228 = the number of working hours.
$\therefore$ 228 × \$0.$12\frac{1}{2}$, or \$28.50 = the amount a laborer receives.

11. 170 lb. : 62.5 lb., or 2.72 = the required ratio.

12. 2 × 36 × 18, or 1296 = the number of square feet in the roof.
1296 = 12.96 hundred.
$\therefore$ 12.96 × 1000 lb., or 12960 lb. = the weight of the roof.

13. 36 sq. in. = $\frac{1}{4}$ sq. ft.
100 sq. ft. : $\frac{1}{4}$ sq. ft., or 400 = the number of slates required.

14. 2000 lb. : 1.33 lb., or 1504 = the number of slates required to weigh a ton.

15. (*a*) 2785 lb. = $1.392\frac{1}{2}$ T.
$\therefore$ $1.392\frac{1}{2}$ × \$8, or \$11.14 = the cost of the straw.
(*b*) 4545 lb. : 60 lb., or $75\frac{3}{4}$ = the number of bushels.
$\therefore$ $75\frac{3}{4}$ × \$0.80, or \$60.60 = the cost of the wheat.
(*c*) 275 = 2.75 hundred.
$\therefore$ 2.75 × \$6, or \$16.50 = the cost of the rails.
(*d*) 285 = .285 thousand.
$\therefore$ .285 × \$30.75, or \$8.76 = the cost of the boards.

16. (*a*) 2000 lb. : 56 lb., or $35\frac{5}{7}$ = the number of bushels.
∴ $35\frac{5}{7} \times \$0.30$, or \$10.71 = the cost of the corn.
(*b*) 6780 lb. = 3.39 T.
∴ $3.39 \times \$16$, or \$54.24 = the cost of the hay.
(*c*) 7656 lb. = 76.56 cwt.
∴ $76.56 \times \$5$, or \$382.80 = the cost of the cattle.
(*d*) 1875 = 1.875 M.
∴ $1.875 \times \$8.75$, or \$16.41 = the cost of the cabbage plants.

17. 33 ft. = 2 rd. ; $\frac{1}{2}$ mi. = 160 rd. ; $\frac{1}{4}$ mi. = 80 rd.
$2 \times 160 + 2 \times 80$, or 480 = the number of square rods in the roads.
2×2, or 4 = the number of square rods to be deducted for the center square.
∴ 476 sq. rd., or $2\frac{39}{40}$ A. = the area of the roads.
$\frac{1}{2} \times \frac{1}{4}$, or $\frac{1}{8}$ = the part of a square mile in the whole farm.
$\frac{1}{8}$ sq. mi. = 80 A.
∴ 80 A. − $2\frac{39}{40}$ A., or $77\frac{1}{40}$ A. = the area left in the farm.

18. 1 cu. in. = the volume of each block.
∴ 105 cu. in. = the entire volume.
$105 = 3 \times 5 \times 7$.
∴ 3 in. × 5 in. × 7 in. = the required dimensions.

19. 12 in. × 8 in. × 6 in. = the dimensions.
∴ $12 \times 8 \times 6$, or 576 = the number of cubic inches in the contents.

20. 4 × 4 ft. + 4 × 3 ft. + 4 × 2 ft., or 38 ft. = the required length.

21. 2 × 8 ft. + 2 × 4 ft., or 24 ft. = the distance around the cord.
∴ 4×24, or 96 = the number of square feet in the sides.
$2 \times (8 \times 4)$, or 64 = the number of square feet in the top and bottom.
∴ 96 sq. ft. + 64 sq. ft., or 160 sq. ft. = the entire surface.

22. 1 gal. = 231 cu. in.
$231 = 11 \times 7 \times 3$.
∴ 11 in. × 7 in. × 3 in. = the integral dimensions of the box.

23. 22 in. : 4 in. = $5\frac{1}{2}$; 18 in. : 4 in. = $4\frac{1}{2}$; 14 in. : 4 in. = $3\frac{1}{2}$.
∴ 5 = the number of blocks in one row along the length.
4 = the number of rows in one layer.
3 = the number of layers.
∴ $5 \times 4 \times 3$, or 60 = the entire number of blocks.

24. 4 in. : $\frac{1}{4}$ in., or 16 = the number of squares in one row along the length.

$3\frac{1}{2}$ in. : $\frac{1}{4}$ in., or 14 = the number of rows.

$\therefore$ 16 × 14, or 224 = the entire number.

25. 24 × 60, or 1440 = the number of minute spaces the minute hand passes over in 1 day.

$\frac{1}{12}$ of 1440, or 120 = the number the hour hand passes over.

26. 8 × 4 × $1\frac{3}{4}$, or 56 = the number of cubic feet of wheat.

56 cu. ft. : $\frac{5}{4}$ cu. ft., or $44\frac{4}{5}$ = the number of bushels.

27. $4\frac{1}{2}$ × $2\frac{1}{4}$ bu., or $10\frac{1}{8}$ bu. = the amount required.

28. $\frac{1}{4}$ of 40 rd., or 10 rd. = the side of the square.

10 × 10 = 100.

$\therefore$ 100 sq. rd. = the required area.

29. $1\frac{1}{4}$ hr. = the time.

58.3 mi. ÷ $1\frac{1}{4}$, or 46.64 mi. = the distance traveled per hour.

30. 2 hr. 40 min. = $2\frac{2}{3}$ hr.

$2\frac{2}{3}$ × 30 mi., or 80 mi. = the distance traveled by the faster.

$\therefore$ 150 mi. − 80 mi., or 70 mi. = the distance traveled by the slower.

70 mi. ÷ $2\frac{2}{3}$, or $26\frac{1}{4}$ mi. = the average speed of the slower.

31. 18 in. : $1\frac{1}{8}$ in., or 16 = the number of boards.

$\therefore$ $16 \times \frac{16 \times 18}{12}$, or 384 = the number of board feet.

32. 2240 lb. = 22.4 hundred.

$\therefore$ 22.4 × \$0.28, or \$6.272 = the selling price per ton.

$\therefore$ \$6.272 − \$3.75, or \$2.522 = the profit on a ton.

$\therefore$ 150 × \$2.522, or \$378.30 = the whole profit.

33. 4 × $2\frac{1}{2}$ × $1\frac{3}{4}$, or $17\frac{1}{2}$ = the number of cubic feet in the block.

$62\frac{1}{2}$ lb. = the weight of 1 cu. ft. of water.

$\therefore$ $17\frac{1}{2}$ × 2.704 × $62\frac{1}{2}$ lb., or 2957.5 lb. = the required weight.

34. 160 = the number of rows.

$\therefore$ 159 = the number of spaces.

159 × $2\frac{3}{4}$ ft., or $437\frac{1}{4}$ ft., or $145\frac{3}{4}$ yd. = the width planted.

$\therefore$ $145\frac{3}{4}$ yd. + 2 yd., or $147\frac{3}{4}$ yd., or $26\frac{19}{22}$ rd. = the width of the field.

35. 32 qt. = 1 bu.
.·. 31 qt. = the amount of chestnuts sold.
31 × $0.10, or $3.10 = the amount received.
.·. $3.10 − $2.40, or $0.70 = the amount gained.

36. 4*s.* 6*d.* = $4\frac{1}{2}$*s.* = £ $\frac{9}{40}$.
£ 1 = $4.8665.
.·. £ $\frac{9}{40}$ = $\frac{9}{40}$ of $4.8665, or $1.09.

37. 80 yd. = 240 ft.
240 × 6, or 1440 = the number of square feet in the surface.
.·. 1440 × 4.428 lb. or 6376.32 lb. = the force exerted.

38. 1 A. = 6272640 sq. in.
6272640 × 39.8 cu. in., or 249651072 cu. in., or 1080741 gal. = the quantity of rain on an acre.

39. 6 × $0.02, or $0.12 = the cost of sending the letter.

40. 22 = the number of minutes to be deducted.
5 hr. − $\frac{22}{60}$ hr., or $4\frac{19}{30}$ hr. = the time required.
.·. 225.3 mi. ÷ $4\frac{19}{30}$, or 48.63 mi. = the average speed per hour.

41. 3 × (90 rd. + 85 rd. + 72 rd. + 60 rd.), or 921 rd. = the length of the wire needed.
.·. 921 × 1 or 921 = the number of pounds needed.

42. 27 hr. = 1440 min.
1440 × 17, or 24480 = the number of inspirations in 24 hr.
24480 × 30 cu. in., or 73440 cu. in., or 425 cu. ft. = the amount of air taken in.

43. 12 × 5 ct., or 60 ct. = the selling price of a dozen.
.·. 60 ct. − 55 ct., or 5 ct. = the gain on a dozen.
1 gross = 12 dozen.
.·. 12 × 5 ct. or 60 ct. = the gain on a gross.

44. 1 lb. 3 oz. = 19 oz. = $9\frac{1}{2}$ × 2 oz.
.·. 10 × $0.01, or $0.10 = the cost of sending.

45. 48 min. = $\frac{4}{5}$ hr.
55.5 mi. = the distance traveled in $\frac{4}{5}$ hr.
.·. 55.5 mi. ÷ $\frac{4}{5}$, or 69.375 mi. = the distance traveled in 1 hr.

46. $70\frac{1}{2}$ cu. in. : 1728 cu. in. = $\frac{141}{3456}$.
.·. $\frac{141}{3456}$ × 1.03 × $62\frac{1}{2}$ lb., or 2.63 lb. = the weight of the milk.

Exercise 98, Page 186.

	hr.	min.	
19.	16	30	was the time of sunset.
	7	26	was the time of sunrise.
	9	4	is the required time.

	da.	hr.	min.	
20.	22	4	23	was the time of sunset.
	21	19	40	was the time of sunrise.
		8	43	is the required time.

	yr.	mo.	da.	
21.	1901	4	5	was the date of A's death.
	1856	7	2	was the date of A's birth.
	44	9	3	was A's age when he died.

That is, 45 yr. = A's age to the nearest year.

	da.	hr.	min.
22.	5	16	15
	1	18	30
	3	9	45

	mo.	da.	hr.	min.
24.	7 (31 da)	1	18	33
	6	2	4	56
		29	13	37

	yr.	mo.	da.	
25.	1901	1	22,	date of death.
	81	7	28,	age at death.
	1819	5	24,	date of birth.

yr.	mo.	da.	
1837	6	20,	date of beginning reign.
1819	5	24,	date of birth.
18		26,	age on beginning reign.

Exercise 99, Page 188.

18. $9\frac{1}{4}$ hr. − $\frac{3}{4}$ hr., or $8\frac{1}{2}$ hr. = the time he worked each day.
$23 \times 8\frac{1}{2} \times \$0.125$, or \$24.44 = the amount earned.

19. $6 \times 60° = 1$ circumference.
∴ 6 × (4 yd. 2 ft. 3 in.), or 28 yd. 1 ft. 6 in. = the required length.

20. $10\frac{1}{2}$ hr. − $\frac{2}{3}$ hr., or $9\frac{5}{6}$ hr. = the time each worked per day.
$7 \times 6 \times 9\frac{5}{6} \times \$0.10$, or \$41.30 = the amount earned.

21. Find the number of square rods in 6 A. 14 sq. rd., and divide by 10.

22. Reduce 4 yd. 2 ft. 6 in. to inches, and divide by 60.

23. 4*s.* 2*d.* = 50*d.*, and £10 4*s.* 6*d.* = 2454*d.*
2454*d.* = $\frac{2454}{50}$ of 50*d.* or $\frac{2454}{50}$ of $1, or $49.08.

24. 2 T. 6 cwt. 40 lb. = 4640 lb.
4640 lb. : 60 lb., or $77\frac{1}{3}$ = the number of bushels.
∴ $77\frac{1}{3}$ × $0.80, or $61.87 = the amount received.

25. £40 10*s.* 6*d.* = £40 $10\frac{1}{2}$*s.* = £$40\frac{21}{40}$.
$40\frac{21}{40}$ × $4.86, or $196.95 = the required cost.

26. 5 da. 15 hr. 46 min. = $135\frac{23}{30}$ hr.
3044 knots ÷ $135\frac{23}{30}$, or 91320 ÷ 4073 [§ 100], or 22.42 knots = the required speed.

29. 42 cwt. 40 lb. − 14 cwt. 80 lb. = 27 cwt. 60 lb., or 2760 lb.
2760 lb. = 2.760 M. lb. = 1.38 T.
1.38 × $16, or $22.08 = the value of the hay.

Exercise 101, Page 193.

[Full solutions to the problems of this exercise should be given as found on p. 193, "Essentials of Arithmetic."]

11.	4 44 31 15 71 7 45	Cambridge is 71° 7′ 45″ west of Greenwich. ∴ 71° 7′ 45″ W. is the longitude of Cambridge.
12.	5 0 38.5 15 75 9 37.5	Philadelphia is 75° 9′ 37.5″ west of Greenwich. ∴ 75° 9′ 37.5″ W. is the longitude of Philadelphia.
13.	5 8 15.7 15 77 3 55.5	Washington is 77° 3′ 55.5″ west of Greenwich. ∴ 77° 3′ 55.5″ W. is the longitude of Washington.
14.	15)74 0 3 4 56 0.2	New York is 4 hr. 56 min. 0.2 sec. west of Greenwich. ∴ 4 hr. 56 min. 0.2 sec. W. is the longitude of New York.
15.	15)2 20 22 9 $21\frac{7}{15}$	Paris is 9 min. $21\frac{7}{15}$ sec. east of Greenwich. ∴ 9 min. $21\frac{7}{15}$ sec. E. is the longitude of Paris.

16. 40° 8′ 16″
36° 6′ 40″
76° 14′ 56″ = the distance the ship sailed.

15)76 14 56 The change in time must be 5 hr. 5 min. to the
5 4 59$\frac{11}{15}$ nearest second.

Since the ship sailed east, the traveler must set his watch forward 5 hr. 5 min. [§ 254, Remark].

17. 15)5° 15′ 6″
21 0.4

The difference in time between any point and a point 5° 15′ 6″ east of it is 21 min. 0.4 sec., and the latter point has noon, Thursday, 21 min. 0.4 sec. before the former. Hence, the time the ship was sailing was 21 min. 0.4 sec. less than 24 hr., or 23 hr. 38 min. 59.6 sec.

18. 15)5 20 15
21 21

The difference in time between any point and a point 5° 20′ 15″ west of it is 21 min. 21 sec., and the latter point has noon 21 min. 21 sec. after the former. Hence, the time the ship was sailing was 24 hr. 21 min. 21 sec.

19. 122° 24′ 15″ W. is the longitude of San Francisco.
71° 3′ 30″ W. is the longitude of Boston.
51° 20′ 45″ is the difference of longitude.

15)51 20 45 The time is 3 hr. 25 min. 23 sec. later at Boston
3 25 23 than at San Francisco, since the former is east of the latter.

da.	hr.	min.	sec.	
4	21	30	0	is the time at San Francisco.
	3	25	23	
5	0	55	23	is the time at Boston.

That is, 55 min. 23 sec. A.M., Thursday, is the time at Boston.

20. 0 58 45.3 The difference of time is 58 min. 45.3 sec.
15 The difference of longitude is 14° 41′ 19.5″.
14 41 19.5 Berlin is east of Oxford, as Berlin has later time than Oxford.

14° 41′ 19.5″ ∴ Berlin is 14° 41′ 19.5″ east of Oxford.
1 15 6 The Prime Meridian is 1° 15′ 6″ east of Oxford.
13 26 13.5 ∴ Berlin is 13° 26′ 13.5″ east of the Prime Meridian.

That is, the longitude of Berlin is 13° 26′ 13.5″ E.

	hr.	min.	sec.	
21.	5	10	13.1	is the time at Providence.
	5			is the time at West Point.
		10	13.1	is the difference of time.

hr.	min.	sec.	
4	55	50.6 W.	is the longitude of West Point. [Note, p. 195.]
	10	13.1	is the difference of longitude.
4	45	37.5 W.	is the longitude of Providence, since it has later time than West Point, and hence must be east of West Point.

22.	12° 27′ 14″ E.	is the longitude of Rome.
	74° 0′ 3″ W.	is the longitude of New York.
	86° 27′ 17″	is the difference of longitude.

15)86 27 17	The difference of time is 5 hr. 45 min. $49\frac{2}{15}$ sec.
5 45 $49\frac{2}{15}$	Rome has later time than New York, since it is east of New York.

da.	hr.	min.	sec.	
3	23	0	0	is the time at New York.
	5	45	$49\frac{2}{15}$	is the difference of time.
4	4	45	$49\frac{2}{15}$	is the time at Rome.

That is, 4 hr. 45 min. $49\frac{2}{15}$ sec. A.M., Wednesday, is the time at Rome.

Exercise 104, Page 204.

2. $275 = the sum deposited.
20%, or $\frac{1}{5}$ of the sum deposited = the sum withdrawn.
∴ $\frac{1}{5}$ of $275, or $55 = the sum withdrawn.
And $275 − $55, or $220 = the sum remaining in bank.

3. 412.5 gr. = the weight of a silver dollar.
10%, or $\frac{1}{10}$ of its weight = the weight of copper alloy.
∴ $\frac{1}{10}$ of 412.5 gr., or 41.25 gr. = weight of copper alloy.
And 412.5 gr. − 41.25 gr., or 371.25 gr. = the weight of the silver.

4. 45215 sq. mi. = the area of Pennsylvania.
.508%, or .00508 × the area = the area of water surface.
.00508 × 45215 sq. mi., or 230 sq. mi. = area of water surface.
And 45215 sq. mi. − 230 sq. mi., or 44985 sq. mi. = area of land surface.

5. $275 = the full value of outstanding bills.
75%, or $\frac{3}{4}$ of the full value = the amount received.
∴ $\frac{1}{4}$ of $275, or $206.25 = the amount received.
And $275 − $206.25, or $68.75 = the amount he lost.

6. 25.8 gr. = the weight of a gold dollar of the United States.
90%, or $\frac{9}{10}$ of its weight = the weight of the pure gold in the coin.
∴ $\frac{9}{10}$ of 25.8 gr., or 23.22 gr. = the weight of pure gold.
And 25.8 gr. − 23.22 gr., or 2.58 gr. = the weight of alloy.

7. 36 lb. = the weight of pewter.
$85\frac{5}{9}$%, or $\frac{77}{90}$ of its weight = the weight of the copper in the pewter.
∴ $\frac{77}{90}$ of 36 lb., or 30.8 lb. = the weight of the copper.
And $14\frac{4}{9}$%, or $\frac{13}{90}$ of the weight of pewter = the weight of the tin in the pewter.
∴ $\frac{13}{90}$ of 36 lb., or 5.2 lb. = the weight of the tin.

8. 250 lb. = the weight of the gunpowder.
75%, or $\frac{3}{4}$ of its weight = the weight of the saltpeter in it.
∴ $\frac{3}{4}$ of 250 lb., or 187.5 lb. = the weight of the saltpeter.
And 10%, or $\frac{1}{10}$ of the weight of gunpowder = the weight of the sulphur in it.
∴ $\frac{1}{10}$ of 250 lb., or 25 lb. = the weight of the sulphur.
And 15%, or $\frac{3}{20}$ of the weight of gunpowder = the weight of the charcoal in it.
∴ $\frac{3}{20}$ of 250 lb., or 37.5 lb. = the weight of the charcoal.

9. 15 cu. ft. = the volume of water.
10%, or $\frac{1}{10}$ of its volume = amount that it expands.
∴ $\frac{1}{10}$ of 15 cu. ft., or 1.5 cu. ft. = amount that it expands.
And 15 cu. ft. + 1.5 cu. ft., or 16.5 cu. ft. = amount of ice required.

10. 288 bu. = the amount of wheat crop.
$12\frac{1}{2}$%, or $\frac{1}{8}$ of amt. of wheat = the amount he sold in July.
∴ $\frac{1}{8}$ of 288 bu., or 36 bu. = the amount he sold in July.
And 288 bu. − 36 bu., or 252 bu. = the amount remaining.
10%, or $\frac{1}{10}$ of the amt. remaining = the amount he sold in August.
∴ $\frac{1}{10}$ of 252 bu., or 25.2 bu. = the amount he sold in August.
And 252 bu. − 25.2 bu., or 226.8 bu. = the amount then remaining.

11. 200 bu. = the amount of potatoes bought.
10%, or $\frac{1}{10}$ of the amt. bought = the amount spoiled.
∴ $\frac{1}{10}$ of 200 bu., or 20 bu. = the amount spoiled.

And 200 bu. – 20 bu., or 180 bu. = the amount remaining.
10%, or $\frac{1}{10}$ of the amt. remaining = the shrinkage.
∴ $\frac{1}{10}$ of 180 bu., or 18 bu. = the shrinkage.
And 180 bu. – 18 bu., or 162 bu. = the amount then remaining.
50 ct. = the cost per bushel of potatoes.
200 bu. = the amount of potatoes bought.
Then 200 × $0.50, or $100 = the cost of the potatoes.
75 ct. = the selling price per bushel of potatoes.
162 bu. = the amount of potatoes sold.
Then, 162 × $0.75, or $121.50 = the selling price of them.
And $121.50 – $100, or $21.50 = the gain on the potatoes.

12. 81388 = population of Richmond, Va., in 1890.
4.5%, or $\frac{9}{200}$ of the population of 1890 = increase in population during 1890–1900.
∴ $\frac{9}{200}$ of 81388, or 3662 = increase in population during 1890–1900.
And 81388 + 3662, or 85050 = population of Richmond in 1900.

13. $\frac{1}{4}$ A. = amount of land he bought.
$33\frac{1}{3}$%, or $\frac{1}{3}$ of amount bought = amount in first lot.
∴ $\frac{1}{3}$ of $\frac{1}{4}$ A., or $\frac{1}{12}$ A. = amount in first lot.
50%, or $\frac{1}{2}$ of amount bought = amount in second lot.
∴ $\frac{1}{2}$ of $\frac{1}{4}$ A., or $\frac{1}{8}$ A. = amount in second lot.
Then, $\frac{1}{12}$ A. + $\frac{1}{8}$ A., or $\frac{5}{24}$ A. = amount in first and second lots.
And $\frac{1}{4}$ A. – $\frac{5}{24}$ A., or $\frac{1}{24}$ A. = amount in third lot.

14. 5%, or $\frac{1}{20}$ of amount of ashes = the amount of potash.
∴ $\frac{1}{20}$ of 2000 lb., or 100 lb. = the amount of potash.
1.5%, or $\frac{3}{200}$ of amount of ashes = the amount of phosphoric acid.
∴ $\frac{3}{200}$ of 2000 lb., or 30 lb. = the amount of phosphoric acid.
32.5%, or $\frac{13}{40}$ of amount of ashes = the amount of lime.
∴ $\frac{13}{40}$ of 2000 lb., or 650 lb. = the amount of lime.

15. 1 bu., or 56 lb. = the amount of corn ground.
10%, or $\frac{1}{10}$ of amount of corn ground = the amount taken for toll.
∴ $\frac{1}{10}$ of 56 lb., or 5.6 lb. = the amount taken for toll.
And 56 lb. – 5.6 lb., or 50.4 lb. = amount remaining.
1%, or $\frac{1}{100}$ of amount of corn ground = amount lost in grinding.
∴ $\frac{1}{100}$ of 56 lb., or .56 lb. = amount lost in grinding.
And 50.4 lb. – .56 lb., or 49.84 lb. = amount of feed returned to farmer.

16. 100 lb. = amount of potatoes.
75%, or $\frac{3}{4}$ of amount of potatoes = amount of water in them.
∴ $\frac{3}{4}$ of 100 lb., or 75 lb. = the amount of water in them.
And 100 lb. − 75 lb., or 25 lb. = remainder.
64.8%, or $\frac{81}{125}$ of remainder = the amount of starch in them.
∴ $\frac{81}{125}$ of 25 lb., or 16.2 lb. = the amount of starch in them.

17. $900 = the value of the barn.
$\frac{2}{3}$ of value of barn = the amount of insurance.
∴ $\frac{2}{3}$ of $900, or $600 = the amount of insurance.
$\frac{3}{4}$%, or $\frac{3}{400}$ of amount insured = the amount of premium.
∴ $\frac{3}{400}$ of $600 or $4.50 = the amount of premium.
And $600 − $4.50, or $595.50 = the value of insurance after paying premium.
∴ $900 − $595.50, or $304.50 = the owner's loss.

18. $3000 = the assessed value of the property.
.2$\frac{1}{4}$%, or $\frac{9}{4000}$ of assessed value = the school tax.
∴ $\frac{9}{4000}$ of $3000, or $6.75 = the school tax.
.1$\frac{1}{2}$%, or $\frac{3}{2000}$ of assessed value = the county tax.
∴ $\frac{3}{2000}$ of $3000 or $4.50 = the county tax.
.3%, or $\frac{3}{1000}$ of assessed value = the road tax.
∴ $\frac{3}{1000}$ of $3000, or $9 = the road tax.
And $6.75 + $4.50 + $9, or $20.25 = the amount of tax paid in 1 yr.

19. 1260 × $0.80, or $1008 = the cost of the carpet.
1260 × $0.45, or $567 = one duty.
40%, or $\frac{2}{5}$ of $1008, or $403.20 = the other duty.
Then $567 + $403.20, or $970.20 = the total duty.

20. 175%, or $\frac{7}{4}$ of the required amount = $375.
$\frac{1}{4}$ of the required amount = $\frac{1}{7}$ of $375, or 53\frac{4}{7}$.
$\frac{4}{4}$ of the required amount = 4 × 53\frac{4}{7}$, or 214\frac{2}{7}$.

21. 166$\frac{2}{3}$%, or $\frac{5}{3}$ of the required number = 12$\frac{1}{2}$.
∴ the required number = $\frac{3}{5}$ of 12$\frac{1}{2}$, or 7$\frac{1}{2}$.

22. 81$\frac{1}{4}$%, or $\frac{13}{16}$ of the required number = 26.
∴ the required number = $\frac{16}{13}$ of 26, or 32.

23. 40%, or $\frac{2}{5}$ of the required number = $\frac{4}{5}$.
∴ the required number = $\frac{5}{2}$ of $\frac{4}{5}$, or 2.

24. 66$\frac{2}{3}$%, or $\frac{2}{3}$ of the required number = 60.
∴ the required number = $\frac{3}{2}$ of 60, or 90.

25. 110%, or $\frac{11}{10}$ of the required weight = 22 lb.
∴ the required weight = $\frac{10}{11}$ of 22 lb., or 20 lb.

26. $66\frac{2}{3}$%, or $\frac{2}{3}$ of the required length = 1 ft.
∴ the required length = $\frac{3}{2}$ of 1 ft., or $1\frac{1}{2}$ ft.

28. 47%, or $\frac{47}{100}$ of the weight of the almonds = the weight of the oil, or 1 lb.
$\frac{1}{100}$ of the weight of the almonds = $\frac{1}{47}$ lb.
$\frac{100}{100}$ of the weight of the almonds = $\frac{100}{47}$ lb., or $2\frac{6}{47}$ lb.

29. 4% of the weight of the milk = the weight of the butter, or 20 lb.
1% of the weight of the milk = $\frac{1}{4}$ of 20 lb., or 5 lb.
100% of the weight of the milk = 100 × 5 lb., or 500 lb.

30. 86.8%, or $\frac{217}{250}$ of the area of Rhode Island = the land surface, or 1085 sq. mi.
$\frac{1}{250}$ of the area of Rhode Island = $\frac{1}{217}$ of 1085 sq. mi., or 5 sq. mi.
$\frac{250}{250}$ of the area of Rhode Island = 250 × 5 sq. mi., or 1250 sq. mi.
And 1250 sq. mi. − 1085 sq. mi., or 165 sq. mi. = the water surface.

31. 200%, or 2 × the cost of 1 paper = the selling price of 1 paper.
$0.05 = the selling price of 1 paper.
∴ 2 × the cost of 1 paper = $0.05.
Whence, the cost of 1 paper = $0.025.

32. 100% of original length − 5% of original length, or 95% of original length, or $\frac{19}{20}$ of original length = $3\frac{4}{5}$ yd., or $\frac{19}{5}$ yd.
∴ $\frac{1}{20}$ of original length = $\frac{1}{19}$ of $\frac{19}{5}$ yd., or $\frac{1}{5}$ yd.
And $\frac{20}{20}$ of original length = 20 × $\frac{1}{5}$ yd., or 4 yd.

33. 100% of the volume of the water + 10% of the volume of the water, or 110% of the volume of the water = the volume of the ice, or 100 cu. ft.
∴ 1% of the volume of the water = $\frac{1}{110}$ of 100 cu. ft., or $\frac{10}{11}$ cu. ft.
And 100% of the volume of the water = 100 × $\frac{10}{11}$ cu. ft., or $90\frac{10}{11}$ cu. ft.

34. 117.1%, or $\frac{1171}{1000}$ of the population in 1890 = the population in 1900, or 30667.
∴ $\frac{1000}{1000}$ of the population in 1890 = $\frac{1000}{1171}$ of 30667, or 26189.

35. $62\frac{1}{2}$%, or $\frac{5}{8}$ of the claim = the amount paid, or $10000.
$\frac{1}{8}$ of the claim = $\frac{1}{5}$ of $10000, or $2000.
$\frac{8}{8}$ of the claim = 8 × $2000, or $16000.
∴ $16000 − $10000, or $6000 = the required loss.

36. 100% of the detachment − 20% of the detachment, or 80% of the detachment = the remainder after first loss.

10% of 80% of the detachment, or 8% of the detachment = the second loss.

Then 72% of the detachment = the remainder, or 72 men.

28% of the detachment = 28 men.

∴ 28 = the number killed.

37. $\frac{4}{5}\%$, or $\frac{1}{125}$ of the assessed value = the premium, or \$8.

∴ 125 × \$8, or \$1000 = the assessed value.

$\frac{3}{4}$ of the real value = the assessed value.

∴ $\frac{3}{4}$ of the real value = \$1000.

∴ $\frac{4}{3}$ of \$1000, or \$1333$\frac{1}{3}$ = the real value.

38. ($\frac{1}{4}\% + \frac{4}{10}\% + \frac{1}{5}\%$), or $\frac{17}{2000}$ of the assessed value = the taxes.

\$34.51 = the taxes.

∴ $\frac{17}{2000}$ of the assessed value = \$34.51.

∴ $\frac{2000}{17}$ of \$34.51, or \$4060 = the assessed value.

39. 80 × \$30, or \$2400 = the assessed value of the farm.

∴ \$2400 = 80%, or $\frac{4}{5}$ of the real value.

∴ $\frac{5}{4}$ of \$2400, or \$3000 = the real value.

And 2400 × \$0.00225, or \$5.40 = the school tax.

41. The weight of the fat is $\frac{4.5}{100}$ of the weight of the corn.

∴ 4.5% is the required rate [§ 261].

42. The weight of the fat is $\frac{.18}{10}$, or $\frac{1.8}{100}$ of the weight of the oats.

∴ 1.8% is the required rate.

43. 2 lb. + 3 lb., or 5 lb. = the amount of mixture.

∴ $\frac{2}{5}$ of the mixture = the amount of black tea.

And $\frac{3}{5}$ of the mixture = the amount of green tea.

∴ $\frac{2}{5}$ of 100%, or 40% = the per cent of black tea.

And $\frac{3}{5}$ of 100%, or 60% = the per cent of green tea.

44. 7455 sq. mi. + 360 sq. mi., or 7815 sq. mi. = the area of New Jersey.

∴ $\frac{7455}{7815}$, or $\frac{497}{521}$ of the area = the amount of land surface.

And $\frac{360}{7815}$, or $\frac{24}{521}$ of the area = the amount of water surface.

∴ $\frac{497}{521}$ of 100%, or 95.393% = the per cent of land surface.

And $\frac{24}{521}$ of 100%, or 4.607% = the per cent of water surface.

45. 57.87 gr. + 19.29 gr., or 77.16 gr. = the weight of the coin.
57.87 = $\frac{3}{4}$ of 77.16, and 19.29 = $\frac{1}{4}$ of 77.16.
∴ $\frac{3}{4}$ of the weight of the coin = the weight of the copper.
And $\frac{1}{4}$ of the weight of the coin = the weight of the nickel.
∴ $\frac{3}{4}$ of 100%, or 75% = the per cent of copper.
And $\frac{1}{4}$ of 100%, or 25% = the per cent of nickel.

46. 12 × $40, or $480 = the salary for 1 yr.
$180 = the house rent.
Then $\frac{3}{8}$ of the salary = the house rent.
∴ $\frac{3}{8}$ of 100%, or 37$\frac{1}{2}$% = the required per cent.

47. 20%, or $\frac{1}{5}$ of 40 yd., or 8 yd. = the amount sold from first piece.
50%, or $\frac{1}{2}$ of 36 yd., or 18 yd. = the amount sold from second piece.
90%, or $\frac{9}{10}$ of 30 yd., or 27 yd. = the amount sold from third piece.
∴ from 106 yd. he sold 53 yd., and had remaining 53 yd.
Then $\frac{53}{106}$, or $\frac{1}{2}$ of 100%, or 50% = the required per cent.

48. $\frac{1}{4}$ of a number = 25% of it.
20% of a number = $\frac{20}{25}$, or $\frac{4}{5}$ of 25% of it.
∴ 20% of a number = $\frac{4}{5}$ of 100%, or 80% of 25% of it.

49. 3437202 = the population of New York in 1900.
2492591 = the population of New York in 1890.
944611 = the increase in 10 yr.
.01 of 2492591, or 24925.91 = the increase at 1%.
24925.91)944611.000(37.89, or 37.9 = the required number of per cent.
7477773
19683370
17448137
22352330
19942728
24096020
22433319

50, **51**, **52**, **53**, **54**, **55**, **56**, **57**, and **58** may be solved like **49**.

59. 231052 volumes = the amount of reading matter issued.
162093 volumes = the amount of fiction issued.
∴ $\frac{162093}{231052}$ of the reading matter issued = the amount of fiction.
∴ $\frac{162093}{231052}$ of 100%, or 70.15% = the required per cent.

60. $5000 = the value of A's store.
⅗ of $5000, or $3000 = the insured value of the store.
.01 of $3000, or $30 = the premium at 1 %.
$37.50 = the premium.
∴ $37.50 : $30, or 1¼ = the required number of per cent.
That is, 1¼ % = the required rate of insurance.

61. 5% of the amount collected = the commission.
∴ 95 % of the amount collected = the amount remaining, or $4750.
1 % of the amount collected = 1/95 of $4750, or $50.
100 % of the amount collected = 100 × $50, or $5000.
Then, $5000 = the tax on $2500000.
.01 of $2500000, or $25000 = the tax at 1 %.
Then, $5000 : $25000, or ⅕ = the required number of per cent.
That is, ⅕ % = the rate of taxation.

Exercise 105, Page 209.

2. 5 %, or 1/20 of $205.40, or $10.27 = the discount.
And $205.40 − $10.27, or $195.13 = the cost.

3. 25 %, or ¼ of $15, or $3.75 = the discount.
And $15 − $3.75, or $11.25 = the cost.

4. 16⅔ %, or ⅙ of $0.15, or $0.025 = the discount.
And $0.15 − $0.025, or $0.125 = the selling price.

5. 25 %, or ¼ of $60, or $15 = the first discount.
∴ $60 − $15, or $45 = the first remainder.
20 %, or ⅕ of $45, or $9 = the second discount.
And $45 − $9, or $36 = the selling price.

6. 10 %, or ⅒ of $2500, or $250 = the first discount.
∴ $2500 − $250, or $2250 = the first remainder.
10 %, or ⅒ of $2250, or $225 = the second discount.
And $2250 − $225, or $2025 = the cost.

7. 30 %, or 3/10 of $400, or $120 = the first discount.
∴ $400 − $120, or $280 = the first remainder.
20 %, or ⅕ of $280, or $56 = the second discount.
∴ $280 − $56, or $224 = the second remainder.
10 %, or ⅒ of $224, or $22.40 = the third discount.
And $224 − $22.40, or $201.60 = the cost.

8. 10%, or $\frac{1}{10}$ of \$250, or \$25 = the first discount.
∴ \$250 − \$25, or \$225 = the first remainder.
20%, or $\frac{1}{5}$ of \$225, or \$45 = the second discount.
∴ \$225 − \$45, or \$180 = the second remainder.
5%, or $\frac{1}{20}$ of \$180, or \$9 = the third discount.
And \$180 − \$9, or \$171 = the cost.

9. 20%, or $\frac{1}{5}$ of \$0.50, or \$0.10 = the first discount.
∴ \$0.50 − \$0.10, or \$0.40 = the first remainder.
20%, or $\frac{1}{5}$ of \$0.40, or \$0.08 = the second discount.
And \$0.40 − \$0.08, or \$0.32 = the second remainder.
5%, or $\frac{1}{20}$ of \$0.32, or \$0.016 = the third discount.
And \$0.32 − \$0.016, or \$0.304 = the amount received.

10. The time from March 1 to April 20 = 50 da.
∴ \$350 will settle the bill, as no discount would be allowed.
The time from March 1 to March 8 = 7 da.
Then, 3%, or $\frac{3}{100}$ of \$350, or \$10.50 = the discount.
∴ \$350 − \$10.50, or \$339.50 = the amount that will settle the bill March 8.
The time from March 1 to March 28 = 27 da.
1%, or $\frac{1}{100}$ of 350, or \$3.50 = the discount.
∴ \$350 − \$3.50, or \$346.50 = the amount that will settle the bill March 28.

11. 100% of the bill = the bill.
7% of the bill = the discount for cash.
∴ 100% of the bill − 7% of the bill, or 93% of the bill = sum sent.
But \$6.51 = the sum sent.
∴ 93% of the bill = \$6.51.
Whence, 1% of the bill = $\frac{1}{93}$ of \$6.51, or \$0.07.
And $\frac{100}{100}$ of the bill = 100 × \$0.07, or \$7.

12. 100% of the bill = the bill.
5% of the bill = the discount.
∴ 100% of the bill − 5% of the bill, or 95% of the bill = sum sent.
But \$213.75 = the sum sent.
∴ 95% of the bill = \$213.75.
Whence, 1% of the bill = $\frac{1}{95}$ of \$213.75, or \$2.25.
And 100% of the bill = 100 × \$2.25, or \$225.
∴ \$225 − \$213.75, or \$11.25 = the discount.

13. 100% of the bill = the bill.
20% of the bill = the first discount.
∴ 100% of the bill − 20% of the bill, or 80% of the bill = 1st rem.
25%, or $\frac{1}{4}$ of 80% of bill, or 20% of the bill = the second discount.
And 80% of the bill − 20% of the bill, or 60% of the bill = the net cost.
But $200 = the net cost.
∴ 60% of the bill = $200.
Whence, 1% of the bill = $\frac{1}{60}$ of $200, or 3\frac{1}{3}$.
And 100% of the bill = 100 × 3\frac{1}{3}$, or 333\frac{1}{3}$.

14. $5 = the marked price.
$3.50 = the selling price.
∴ $5 − $3.50, or $1.50 = the discount.
1% of $5, or $0.05 = the discount at 1%.
∴ $1.50 : $0.05, or 30 = the number of per cent in the rate.
Or, 30% = the required rate of discount.

15. $0.16 = the marked price.
$0.125 = the selling price.
∴ $0.16 − $0.125, or $0.035 = the discount.
1% of $0.16, or $0.0016 = the discount at 1%.
∴ $0.035 : $0.0016, or 21$\frac{7}{8}$ = number of per cent in the rate.
Or, 21$\frac{7}{8}$% = the required rate of discount.

16. $2 = the marked price.
$1.65 = the selling price.
∴ $2 − $1.65, or $0.35 = the discount.
1% of $2, or $0.02 = the discount at 1%.
∴ $0.35 : $0.02, or 17$\frac{1}{2}$ = the number of per cent in the rate.
Or, 17$\frac{1}{2}$% = the required rate of discount.

17. $2.50 = the marked price.
$2 = the selling price.
∴ $2.50 − $2, or $0.50 = the discount.
1% of $2.50, or $0.025 = the discount at 1%.
∴ $0.50 : $0.025, or 20 = the number of per cent in the rate.
Or, 20% = the required rate of discount.

18. $25 = the marked price.
$18 = the selling price.
∴ $25 − $18, or $7 = the discount.

1% of $25, or $0.25 = the discount at 1%.
∴ $7 : $0.25, or 28 = the number of per cent in the rate.
Or, 28% = the required rate of discount.

19. 40% of l. p. = first discount.
∴ 60% of l. p. = first remainder.
10% of 60% l. p., or 6% l. p. = second discount.
∴ 54% l. p. = cost by first condition.
20% l. p. = first discount.
∴ 80% l. p. = first remainder.
20% of 80% l. p., or 16% l. p. = second discount.
∴ 64% l. p. = cost by second condition.
Hence, it is cheaper by 10% l. p. to buy at 40% and 10% discount.

20. 20% l. p. = first discount.
∴ 80% l. p. = first remainder.
10% of 80% l. p., or 8% l. p. = second discount.
∴ 72% l. p. = 2d rem., or cost by first condition.
10% l. p. = first discount.
∴ 90% l. p. = first remainder.
20% of 90% l. p., or 18% l. p. = second discount.
∴ 72% l. p. = 2d rem., or cost by 2d condition.
∴ The discount in each case is 18% of l. p.

21. STEELTON, PA., Aug. 6, 1900.

MR. B. B. WITMER,

To CAPITAL SHIRT CO., *Dr.*,

Manufacturers of Shirts.

TERMS, 30 DA., 5%; 10 DA., 6%.

1	doz.	# 407	Shirts	$4.75	4	75		
½	"	354	"	6.50	3	25		
½	"	453	"	9.00	4	50		
½	"	C/7	"	4.50	2	25		
1⅙	"	641	"	4.50	5	25		
⅔	"	13625	"	4.50	3	00		
1	"	693	"	4.75	4	75	27	75
			Less 6%				1	66
							26	09

22. Philadelphia, May 1, 1903.

Mr. J. S. Peters,

To The Central News Co., *Dr.*

36 boxes Paper, #3403,	@	16¢	5	76		
24 “ “ #246,	@	15¢	3	60		
24 “ “ #930,	@	9¢	2	16		
36 “ “ #366,	@	18¢	6	48		
24 “ “ #948,	@	14¢	3	36		
1 quire Blotting Paper,	@	60¢		60	21	96
Less 20%					4	39
					17	57

23. 417 Market St., Philadelphia, Mar. 30, 1900.

Mr. L. I. Crawford,

To A. S. Downie, *Dr.*

Terms, 30 da.; 1% cash in 10 da.

3 lb. Erasers, #60,	@	75¢	2	25		
3 gr. Isaac Stub Pens, #7,	@	$1.00	3	00		
2 doz. Eye Shades,	@	90¢	1	80		
1 M. Envelopes, #1562-4,	@	$1.50	1	50	8	55
Less 1%						09
					8	46

Exercise 106, Page 212.

41. $3 = the list price.
20%, or $\frac{1}{5}$ of $3, or $0.60 = the discount.
∴ $3 − $0.60, or $2.40 = the cost.
20%, or $\frac{1}{5}$ of the cost = the gain.
∴ $\frac{1}{5}$ of $2.40, or $0.48 = the gain.

42. $0.25 = the list price.
25%, or $\frac{1}{4}$ of $0.25, or 0.06\frac{1}{4}$ = the discount.
∴ $0.25 − 0.06\frac{1}{4}$, or 0.18\frac{3}{4}$ = the cost.
12$\frac{1}{2}$%, or $\frac{1}{8}$ of the cost = the gain.
∴ $\frac{1}{8}$ of 0.18\frac{3}{4}$, or 0.02\frac{11}{32}$ = the gain.

43. $45 = the list price.
11⅑%, or ⅑ of $45, or $5 = the discount.
∴ $45 − $5, or $40 = the cost.
6¼%, or 1/16 of the cost = the loss.
∴ 1/16 of $40, or $2.50 = the loss.

44. $100 = the list price.
20%, or ⅕ of $100, or $20 = the first discount.
∴ $100 − $20, or $80 = the first remainder.
10%, or 1/10 of $80, or $8 = the second discount.
∴ $80 − $8, or $72 = the cost.
5%, or 1/20 of the cost = the loss.
∴ 1/20 of $72, or $3.60 = the loss.

45. $6 = the list price.
33⅓%, or ⅓ of $6, or $2 = the discount.
∴ $6 − $2, or $4 = the cost.
$6 = the selling price.
∴ $6 − $4, or $2 = the gain.
Whence, ½ of the cost = the gain.
∴ ½ of 100%, or 50% = the rate of gain.

46. $0.40 = the list price.
10%, or 1/10 of $0.40, or $0.04 = the discount.
∴ $0.40 − $0.04, or $0.36 = the cost.
$0.48 = the selling price.
∴ $0.48 − $0.36, or $0.12 = the gain.
Whence, ⅓ of the cost = the gain.
∴ ⅓ of 100%, or 33⅓% = the rate of gain.

47. $0.04 = the list price.
25%, or ¼ of $0.04, or $0.01 = the discount.
∴ $0.04 − $0.01, or $0.03 = the cost.
$0.02 = the selling price.
∴ $0.03 − $0.02, or $0.01 = the loss.
Whence, ⅓ of the cost = the loss.
∴ ⅓ of 100%, or 33⅓% = the rate of loss.

48. $25 = the list price.
25%, or ¼ of $25, or $6.25 = the discount.
∴ $25 − $6.25, or $18.75 = the cost.
$20 = the selling price.
∴ $20 − $18.75, or $1.25 = the gain.

1 % of $18.75, or $0.1875 = the gain at 1 %.
∴ $1.25 : $0.1875, or $6\frac{2}{3}$ = the number of per cent gained.
Whence, $6\frac{2}{3}$ % = the rate of gain.

49. $0.52 = the cost per dozen.
$0.60 = the selling price per dozen.
∴ $0.60 – $0.52, or $0.08 = the gain per dozen.
Whence, $\frac{8}{52}$, or $\frac{2}{13}$ of the cost = the gain.
∴ $\frac{2}{13}$ of 100 %, or $15\frac{5}{13}$ % = the rate of gain.

50. $1.50 = the marked price.
20 %, or $\frac{1}{5}$ of $1.50, or $0.30 = the discount.
∴ $1.50 – $0.30, or $1.20 = the selling price, or cost to retailer.
40 %, or $\frac{2}{5}$ of $1.20, or $0.48 = the gain.
∴ $1.20 + $0.48, or $1.68 = the retail price.

51. 100 % of the cost = the cost.
200 % of the cost = the selling price.
∴ 200 % of cost – 100 % of cost, or 100 % of cost = the gain.
Whence, 100 % = the rate of gain.

52. 100 % of the cost = the cost.
50 % of the cost = the selling price.
∴ 100 % of cost – 50 % of cost, or 50 % of the cost = the loss.
Whence, 50 % = the rate of loss.

53. 25 %, or $\frac{1}{4}$ of the cost = the loss.
∴ $\frac{3}{4}$ of the cost = the selling price.
But $6 = the selling price.
∴ $\frac{3}{4}$ of the cost = $6.
Whence, $\frac{1}{4}$ of the cost = $\frac{1}{3}$ of $6, or $2 = the loss.

54. 20 %, or $\frac{1}{5}$ of the cost = the profit offered.
∴ $\frac{6}{5}$ of the cost = the price offered.
$180 = the price offered.
∴ $\frac{6}{5}$ of the cost = $180.
Whence, $\frac{1}{5}$ of the cost = $\frac{1}{6}$ of $180, or $30.
And $\frac{5}{5}$ of the cost = 5 × $30, or $150.
$125 = the selling price.
∴ $150 – $125, or $25 = the loss.
Whence, $\frac{25}{150}$, or $\frac{1}{6}$ of the cost = the loss.
∴ $\frac{1}{6}$ of 100 %, or $16\frac{2}{3}$ % = the rate of loss.

55. 44%, or $\frac{11}{25}$ of the cost = the gain.
∴ $\frac{36}{25}$ of the cost = the selling price.
But $0.02 = the selling price of each.
∴ $\frac{36}{25}$ of the cost = $0.02.
Whence, $\frac{1}{25}$ of the cost = $\frac{1}{36}$ of $0.02, or 0.000\frac{5}{9}$.
And $\frac{25}{25}$ of the cost = 25 × 0.000\frac{5}{9}$, or 0.013\frac{8}{9}$.
Whence, 144 × 0.013\frac{8}{9}$, or $2 = the cost per gross.

56. $1.50 = the cost per dozen.
20%, or $\frac{1}{5}$ of $1.50, or $0.30 = the gain per dozen.
∴ $1.50 + $0.30, or $1.80 = the selling price per dozen.
And $1.80 ÷ 12, or $0.15 = the selling price apiece.

57. 30 ct. = the list price per dozen.
20%, or $\frac{1}{5}$ of $0.30, or $0.06 = the discount.
∴ $0.30 – $0.06, or $0.24 = the cost per dozen.
$0.24 ÷ 12, or $0.02 = the cost apiece.
$0.03 = the selling price apiece.
∴ $0.03 – $0.02, or $0.01 = the gain.
Whence, $\frac{1}{2}$ of the cost = the gain.
∴ $\frac{1}{2}$ of 100%, or 50% = the rate of gain.

58. $5 = the cost.
50%, or $\frac{1}{2}$ of $5, or $2.50 = the advance.
∴ $5 + $2.50, or $7.50 = the marked price.
30%, or $\frac{3}{10}$ of $7.50, or $2.25 = the discount.
∴ $7.50 – $2.25, or $5.25 = the selling price.
∴ $5.25 – $5, or $0.25 = the gain.
Whence, $\frac{25}{500}$, or $\frac{1}{20}$ of the cost = the gain.
∴ $\frac{1}{20}$ of 100%, or 5% = the rate of gain.

59. 25%, or $\frac{1}{4}$ of the cost = the loss.
∴ $\frac{3}{4}$ of the cost = the selling price.
$2.40 = the selling price.
∴ $\frac{3}{4}$ of the cost = $2.40.
Whence, $\frac{1}{4}$ of the cost = $\frac{1}{3}$ of $2.40, or $0.80.
And $\frac{4}{4}$ of the cost = 4 × $0.80, or $3.20.
20%, or $\frac{1}{5}$ of the cost = the advance.
∴ $\frac{1}{5}$ of $3.20, or $0.64 = the advance.
Then, $3.20 + $0.64, or $3.84 = the marked price.

60. 1 ct. = the cost apiece.
2 ct. = the selling price.
∴ 2 ct. − 1 ct., or 1 ct. = the gain.
∴ the cost = the gain.
Or, 100% = the rate of gain.

61. $16\frac{2}{3}\%$, or $\frac{1}{6}$ of \$0.60, or \$0.10 = first discount.
∴ \$0.60 − \$0.10, or \$0.50 = first remainder.
4% of \$0.50, or \$0.02 = second discount.
∴ \$0.50 − \$0.02, or \$0.48 = the cost per square yard.
\$0.60 = the selling price per square yard.
∴ \$0.12 = the gain per square yard.
∴ $\frac{1}{4}$ of cost = gain.
Or, $\frac{1}{4}$ of 100%, or 25% = the rate of gain.

62. \$2.50 = the cost of 100 lb.
5% of 100 lb., or 5 lb. = the loss in weighing.
∴ 95 lb. = the amount sold.
95 × \$0.04, or \$3.80 = selling price.
∴ \$3.80 − \$2.50, or \$1.30 = gain.
Then, $\frac{13}{25}$ of cost = gain.
Or, $\frac{13}{25}$ of 100%, or 52% = the rate of gain.

63. 25%, or $\frac{1}{4}$ of the cost = the loss.
∴ $\frac{3}{4}$ of the cost = the selling price.
But \$6 = the selling price.
∴ $\frac{3}{4}$ of the cost = \$6.
Whence, $\frac{1}{4}$ of the cost = $\frac{1}{3}$ of \$6, or \$2.
And $\frac{4}{4}$ of the cost = 4 × \$2, or \$8.
\$7.50 = the supposed selling price.
∴ \$8 − 7.50, or \$0.50 = the loss.
Whence, $\frac{50}{800}$ or $\frac{1}{16}$ of the cost = the loss.
Or, $\frac{1}{16}$ of 100%, or $6\frac{1}{4}\%$ = the rate of loss.

64. \$0.20 = the cost per pound.
20%, or $\frac{1}{5}$ of \$0.20, or \$0.04 = the gain.
∴ \$0.20 + \$0.04, or \$0.24 = the selling price per pound.
∴ \$0.10 : \$0.24, or $\frac{5}{12}$ = the part of a pound that should be sold for 10 ct.
16 oz. = 1 lb.
∴ $\frac{5}{12}$ of 16 oz., or $6\frac{2}{3}$ oz. = required weight.

65. \$0.20 = the cost per dozen.
50%, or $\frac{1}{2}$ of \$0.20, or \$0.10 = the gain.
∴ \$0.20 + \$0.10, or \$0.30 = the selling price per dozen.
Whence, $\frac{1}{4}$ of \$0.30, or \$0.075 = the selling price of 3 oranges.

66. 94% of cost = the selling price.
∴ 6% of cost = the loss, or \$0.36.
∴ 1% of cost = $\frac{1}{6}$ of \$0.36, or \$0.06.
And 100% of cost = 100 × \$0.06, or \$6.
Then, \$6 − \$0.36, or \$5.64 = the selling price.

67. 125% of cost = the selling price.
∴ 25% of cost = the gain, or \$1.
∴ 100% of cost = 4 × \$1, or \$4.
Then, \$4 + \$1, or \$5 = the selling price.

68. \$75 = the cost.
20%, or $\frac{1}{5}$ of \$75, or \$15 = the gain.
Then, \$90 = the selling price after a discount of \$10 was allowed.
∴ \$100 = the asking price.
Then, \$10 was the discount offered on \$100.
∴ the rate was 10%.

69. 150%, or $\frac{3}{2}$ of the cost of 6 boxes = 10 ct.
∴ the cost of 6 boxes = $\frac{2}{3}$ of 10 ct., or $6\frac{2}{3}$ ct.
2 boxes for 5 ct., or 6 boxes for 15 ct. = the supposed selling price.
Then, 15 ct. − $6\frac{2}{3}$ ct., or $8\frac{1}{3}$ ct. = the gain.
$\frac{8\frac{1}{3}}{6\frac{2}{3}}$, or $\frac{5}{4}$ of 100%, or 125% = the rate of gain.

70. 120%, or $\frac{6}{5}$ of 12 ct., or $14\frac{2}{5}$ ct. = the selling price of each 1 lb. bought.
80%, or $\frac{4}{5}$ of each 1 lb. bought = the amount left to sell.
∴ $\frac{4}{5}$ lb. must be sold for $14\frac{2}{5}$ ct.
$\frac{1}{5}$ lb. must be sold for $3\frac{3}{5}$ ct.
$\frac{5}{5}$ lb. must be sold for 18 ct.

71. 120%, or $\frac{6}{5}$ of 10 ct., or 12 ct. = the selling price of each 1 lb. bought.
80%, or $\frac{4}{5}$ of 1 lb. bought = the weight left to sell.
∴ $\frac{4}{5}$ lb. must be sold for 12 ct.
$\frac{5}{5}$ lb. must be sold for $\frac{5}{4}$ of 12 ct., or 15 ct.

72. 2240 lb. = 22.4 × 100 lb.
22.4 × $0.28, or $6.272 = the selling price per ton.
$4 = the cost per ton.
Then, $6.272 − $4, or $2.272 = the gain per ton.
.01 × $4, or $0.04 = the gain at 1%.
Then, $2.272 : $0.04, or $56\frac{4}{5}$ = the number of per cent in the rate.
That is, $56\frac{4}{5}$% = the rate of gain.

Exercise 107, Page 217.

3. $210 = the amount of sales.
25%, or $\frac{1}{4}$ of the amount of sales = the commission.
∴ $\frac{1}{4}$ of $210, or $52.50 = the commission.

4. 520 × $0.15, or $78 = the amount of sales.
5%, or $\frac{1}{20}$ of the amount of sales = the commission.
∴ $\frac{1}{20}$ of $78, or $3.90 = the commission.
And $78 − $3.90, or $74.10 = the net proceeds.

5. 800 × $0.18, or $144 = the amount of sales.
4%, or $\frac{1}{25}$ of the amount of sales = the commission.
∴ $\frac{1}{25}$ of $144, or $5.76 = the commission.
$1.50 = the delivery charges.
∴ $1.50 + $5.76, or $7.26 = the total expense.
And $144 − $7.26, or $136.74 = the net proceeds.

6. $3750 = the amount of sales.
4%, or $\frac{1}{25}$ of the amount of sales = the commission.
∴ $\frac{1}{25}$ of $3750, or $150 = the commission.
$7.60 = additional expenses.
∴ $7.60 + $150, or $157.60 = total expenses.
And $3750 − $157.60, or $3592.40 = the net proceeds.

7. $30 = the amount of sales.
5%, or $\frac{1}{20}$ of the amount of sales = the commission.
∴ $\frac{1}{20}$ of $30, or $1.50 = the commission.
$2.50 = delivery charges.
∴ $2.50 + $1.50, or $4 = total expenses.
And $30 − $4, or $26 = the net proceeds.

8. 20 × $18, or $360 = the cost of the bran.
4%, or $\frac{1}{25}$ of the cost of the bran = the commission.
∴ $\frac{1}{25}$ of $360, or $14.40 = the commission.
Then, $360 + $14.40, or $374.40 = the entire cost.

9. \$4000 = the cost of the house.
4%, or $\frac{1}{25}$ of the cost of the house = the commission.
∴ $\frac{1}{25}$ of \$4000, or \$160 = the commission.
\$4.50 = additional expenses.
∴ \$4000 + \$160 + \$4.50, or \$4164.50 = the entire cost.

10. \$0.40 = the cost per bushel.
2%, or $\frac{1}{50}$ of the cost per bushel = commission on 1 bu.
∴ $\frac{1}{50}$ of \$0.40, or \$0.008 = the commission on 1 bu.
Then, \$0.40 + \$0.008, or \$0.408 = the entire cost of 1 bu.
But, \$816 = the entire cost of all.
∴ \$816 : \$0.408, or 2000 = the number of bushels bought.

11. \$1200 = the amount of the debt.
60%, or $\frac{3}{5}$ of the amount of debt = the amount collected.
∴ $\frac{3}{5}$ of \$1200, or \$720 = the amount collected.
20%, or $\frac{1}{5}$ of the amount collected = the commission.
∴ $\frac{1}{5}$ of \$720, or \$144 = the commission.
And \$720 − \$144, or \$576 = the remittance.

12. \$625 = the amount of personal property.
5%, or $\frac{1}{20}$ of the amount of personal property = first commission.
∴ $\frac{1}{20}$ of \$625, or \$31.25 = the first commission.
\$3020 = the amount of real estate.
2½%, or $\frac{1}{40}$ of amount of real estate = second commission.
∴ $\frac{1}{40}$ of \$3020, or \$75.50 = the second commission.
And \$31.25 + \$75.50, or \$106.75 = the entire commission.

13. \$4 = the price per barrel.
5%, or $\frac{1}{20}$ of the price per barrel = the commission on 1 bbl.
∴ $\frac{1}{20}$ of \$4, or \$0.20 = the commission on 1 bbl.
Then, \$4 + \$0.20, or \$4.20 = total cost of 1 bbl.
\$2000 = the amount to invest.
∴ \$2000 : \$4.20, or 476 = the number of barrels bought, with surplus of \$0.80.

14. \$3500 = the amount of sales.
3%, or $\frac{3}{100}$ of the amount of sales = the commission.
∴ $\frac{3}{100}$ of \$3500, or \$105 = the commission.
\$25.60 = additional expenses.
∴ \$105 + \$25.60, or \$130.60 = total expenses.
And \$3500 − \$130.60, or \$3369.40 = the amount B should receive.

15. 600 × \$0.70, or \$420 = the cost of the wheat.
$2\frac{1}{2}\%$, or $\frac{1}{40}$ of the cost of the wheat = the commission.
∴ $\frac{1}{40}$ of \$420, or \$10.50 = the commission.
\$18.50 = freight charges.
∴ \$18.50 + \$10.50, or \$29 = total expenses.
And \$420 + \$29, or \$449 = the amount to be sent agent.

16. 5% of the amount expended = the commission.
∴ 105% of the amount expended = the amount received.
\$210 = the amount received.
∴ 105% of the amount expended = \$210.
Whence, 1% of the amount expended = $\frac{1}{105}$ of \$210, or \$2.
And 100% of the amount expended = 100 × \$2, or \$200.
∴ 5% of \$200, or \$10 = the commission.

17. 2.5% of the amount expended = the commission.
∴ 102.5% of the amount expended = the amount sent.
\$512.50 = the amount sent.
∴ 102.5% of the amount expended = \$512.50.
Whence, 1% of the amount expended = \$512.50 ÷ 102.5, or \$5.
And 100% of the amount expended = 100 × \$5, or \$500.
∴ $2\frac{1}{2}\%$, or $\frac{1}{40}$ of \$500, or \$12.50 = the commission.

18. 60 × \$5, or \$300 = the amount of sales.
2%, or $\frac{1}{50}$ of the amount of sales = the commission.
∴ $\frac{1}{50}$ of \$300, or \$6 = the commission.
And \$300 − \$6, or \$294 = the net proceeds of the sale.
\$0.50 = the price per bushel of corn.
2%, or $\frac{1}{50}$ of the price per bushel = the commission on 1 bu.
∴ $\frac{1}{50}$ of \$0.50, or \$0.01 = the commission on 1 bu.
And \$0.50 + \$0.01, or \$0.51 = the total cost per bushel.
\$294 = the amount to be invested.
∴ \$294 : \$0.51, or 576 = the number of bushels bought, with a surplus of \$0.24.

19. 15% of the amount collected = the commission.
∴ 85% of the amount collected = the net proceeds.
\$850 = the net proceeds.
∴ 85% of the amount collected = \$850.
Whence, 1% of the amount collected = $\frac{1}{85}$ of \$850, or \$10.
And 100% of the amount collected = 100 × \$10, or \$1000.
∴ 15%, or $\frac{3}{20}$ of \$1000, or \$150 = the commission.

20. $450 = the net proceeds of a sale.
$50 = the commission.
∴ $450 + $50, or $500 = the amount of the sale.
Then, $\frac{50}{500}$, or $\frac{1}{10}$ of the amount of sales = the commission.
Whence, 10% = the rate of commission charged.

21. $520 = the net proceeds of a sale.
$60 = the commission.
$20 = the freight charges.
∴ $520 + $60 + $20, or $600 = the amount of the sale.
Then, $\frac{60}{600}$, or $\frac{1}{10}$ of the amount of sales = the commission.
Whence, 10% = the rate of commission charged.

22. 400 × $0.80, or $320 = the cost of the wheat.
$336 = the cost of the wheat and commission.
∴ $336 − $320, or $16 = the commission.
Then, $\frac{16}{320}$, or $\frac{1}{20}$ of the cost of wheat = the commission.
Whence, 5% = the rate of commission charged.

23. $200 = the freight charges.
$400 = the commission.
∴ $200 + $400, or $600 = the total expenses.
$4600 = the total cost of the horses.
∴ $4600 − $600, or $4000 = the amount of the purchase.
Then, $\frac{400}{4000}$, or $\frac{1}{10}$ of amount of purchase = the commission.
Whence, 10% = the rate of commission charged.

Exercise 108, Page 221.

3. The time the principal is on interest is 2 yr.
.06 × $60, or $3.60 = the interest for 1 yr.
∴ 2 × $3.60, or $7.20 = the required interest.

4. The time the principal is on interest is 1½ yr.
.04 × $100, or $4 = the interest for 1 yr.
∴ 1½ × $4, or $6 = the required interest.

5. The time the principal is on interest is 2¾ yr.
.04 × $50, or $2 = the interest for 1 yr.
∴ 2¾ × $2, or $5.50 = the required interest.

6. The time the principal is on interest is 3 yr. 90 da., or $3\frac{1}{4}$ yr.
.05 × $375, or $18.75 = the interest for 1 yr.
∴ $3\frac{1}{4}$ × $18.75, or $$60.93\frac{3}{4}$, or $60.94 = the required interest.

7. The time from May 1 to Dec. 31 =
(30 + 30 + 31 + 31 + 30 + 31 + 30 + 31) da. = 244 da.
∴ the time the principal is on interest is 244 da., or $\frac{61}{90}$ yr.
.04 × $378, or $15.12 = the interest for 1 yr.
∴ $\frac{61}{90}$ × $15.12, or $$10.24\frac{4}{5}$, or $10.25 = the required interest.

8. The time from Jan. 1, 1900, to Jan. 1, 1902, is 2 yr.
The time from Jan. 1, 1902, to Sept. 21, 1902 =
(30 + 28 + 31 + 30 + 31 + 30 + 31 + 31 + 21) da., or 263 da.
∴ the time the principal is on interest is 2 yr. 263 da., or $2\frac{263}{360}$ yr.
.045 × $1000, or $45 = the interest for 1 yr.
∴ $2\frac{263}{360}$ × $45, or $122.88 = the required interest.

9. The time the principal is on interest is 1 yr. 78 da., or $1\frac{13}{60}$ yr.
.048 × $50.75, or $2.436 = the interest for 1 yr.
∴ $1\frac{13}{60}$ × $2.436, or $2.963, or $2.96 = the required interest.

10. The time the principal is on interest is 334 da., or $\frac{167}{180}$ yr.
.045 × $225, or $10.125 = the interest for 1 yr.
∴ $\frac{167}{180}$ × $10.125, or $9.393, or $9.39 = the required interest.

11. The time from June 8, 1900, to June 8, 1901, is 2 half years.
The time from June 8, 1901, to Sept. 4, 1901 =
(22 + 31 + 31 + 4) da., or 88 da., or $2\frac{88}{180}$ half years.
.02 × $278, or $5.56 = the interest for 1 half year.
∴ $2\frac{88}{180}$ × $5.56, or $$13.83\frac{37}{45}$, or $13.84 = the required interest.

12. The time from June 18, 1900, to March 18, 1901, is 9 mo., or 3 quarters.

The time from March 18, 1901, to April 1, 1901, is (13 + 1) da., or 14 da., or $\frac{14}{90}$ of a quarter.

∴ the time the principal is on interest is $3\frac{14}{90}$ quarters.
.015 × $75.85, or $1.137 = the interest for 1 quarter.
∴ $3\frac{14}{90}$ × $1.137, or $3.587, or $3.59 = the required interest.

13. The time from May 1 to Dec. 1 is 7 mo.
The time from Dec. 1 to Dec. 18 is 17 da.
∴ the time the principal is on interest is 7 mo. 17 da., or $7\frac{17}{30}$ mo.
.00$\frac{3}{4}$ × $200, or $1.50 = the interest for 1 mo.
∴ $7\frac{17}{30}$ × $1.50, or $11.35 = the required interest.

14. The time the principal is on interest is 246 da.
41 mills, or $0.041 = the interest on $1 for the given time and rate.
Whence, 225 × $0.041, or $9.225, or $9.23 = the required interest.

15. The time the principal is on interest is 2 yr. 18 da.
3 mills, or $0.003 = the interest on $1 for 18 da. at 6 %.
And $0.12 = the interest on $1 for 2 yr. at 6 %.
∴ $0.123 = the interest on $1 for given time and rate.
Whence 450 × $0.123, or $55.35 = the required interest.

16. The time from Dec. 1, 1900, to July 1, 1901, is
(30 + 31 + 28 + 31 + 30 + 31 + 30 + 1) da., or 212 da.
∴ the time the principal is on interest is 212 da.
$35\frac{1}{3}$ mills, or $\$0.035\frac{1}{3}$ = the interest on $\$1$ for the given time and rate.
Whence, 480 × $\$0.035\frac{1}{3}$, or $\$16.96$ = the required interest.

17. The time from May 1, 1899, to May 1, 1901, is 2 yr.
The time from May 1, 1901, to July 2, 1901, is
(30 + 30 + 2) da., or 62 da.
∴ the time the principal is on interest is 2 yr. 62 da.
$10\frac{1}{3}$ mills, or $\$0.010\frac{1}{3}$ = the interest on $\$1$ for 62 da. at 6 %.
∴ $\$0.001\frac{13}{18}$ = the interest on $\$1$ for 62 da. at 1 %.
And $\$0.006\frac{8}{9}$ = the interest on $\$1$ for 62 da. at 4 %.
$0.08 = the interest on $1 for 2 yr.
∴ $\$0.086\frac{8}{9}$ = the interest on $\$1$ for the given time and rate.
Whence, 2000 × $\$0.086\frac{8}{9}$, or $\$173.78$ = the required interest.

18. The time the principal is on interest is 1 yr. 91 da.
$15\frac{1}{6}$ mills, or $\$0.015\frac{1}{6}$ = the interest on $\$1$ for 91 da. at 6 %.
∴ $\$0.002\frac{19}{36}$ = the interest on $\$1$ for 91 da. at 1 %.
And $\$0.0113\frac{3}{4}$ = the interest on $\$1$ for 91 da. at $4\frac{1}{2}$ %.
$0.045 = the interest on $1 for 1 yr.
∴ $\$0.0563\frac{3}{4}$ = the interest on $\$1$ for the given time and rate.
Whence, 820 × $\$0.0563\frac{3}{4}$, or $\$46.23$ = the required interest.

19. The time the principal is on interest is 1 yr. 137 da.
$22\frac{5}{6}$ mills, or $\$0.022\frac{5}{6}$ = the interest on $\$1$ for 137 da. at 6 %.
∴ $\$0.003\frac{29}{36}$ = the interest on $\$1$ for 137 da. at 1 %.
And $\$0.0285\frac{5}{12}$ = the interest on $\$1$ for 137 da. at $7\frac{1}{2}$ %.
$0.075 = the interest on $1 for 1 yr.
∴ $\$0.1035\frac{5}{12}$ = the interest on $\$1$ for given time and rate.
Whence, 28.80 × $\$0.1035\frac{5}{12}$, or $\$2.89$ = the required interest.

20. The time the principal is on interest is 2 yr. 123 da.
20½ mills, or $0.020½ = the interest on $1 for 123 da. at 6 %.
∴ $0.010¼ = the interest on $1 for 123 da. at 3 %.
$0.06 = the interest on $1 for 2 yr.
∴ $0.070¼ = the interest on $1 for given time and rate.
Whence, 627 × $0.070¼, or $44.05 = the required interest.

21. The time the principal is on interest is 1 yr. 50 da.
8⅓ mills, or $0.008⅓ = the interest on $1 for 50 da. at 6 %.
∴ 0.001\frac{7}{18}$ = the interest on $1 for 50 da. at 1 %.
And 0.006\frac{17}{18}$ = the interest on $1 for 50 da. at 5 %.
$0.05 = the interest on $1 for 1 yr. at 5 %.
∴ 0.056\frac{17}{18}$ = the interest on $1 for the given time and rate.
Whence, 528.60 × 0.056\frac{17}{18}$, or $30.10 = the required interest.

22. The time the principal is on interest is 2 yr. 60 da.
10 mills, or $0.01 = the interest on $1 for 60 da. at 6 %.
∴ $0.001⅔ = the interest on $1 for 60 da. at 1 %.
And $0.005 = the interest on $1 for 60 da. at 3 %.
$0.06 = the interest on $1 for 2 yr.
∴ $0.065 = the interest on $1 for the given time and rate.
Whence, 420 × $0.065, or $27.30 = the required interest.

23. The time the principal is on interest is 1 yr. 59 da.
9⅚ mills, or $0.009⅚ = the interest on $1 for 59 da. at 6 %.
∴ 0.001\frac{23}{36}$ = the interest on $1 for 59 da. at 1 %.
And $0.0078⅔ = the interest on $1 for 59 da. at 4⅘ %.
$0.048 = the interest on $1 for 1 yr. at 4⅘ %.
∴ $0.0558⅔ = the interest on $1 for the given time and rate.
Whence, 680 × $0.0558⅔, or $37.99 = the required interest.

24. The time the principal is on interest is 60 da.
$2.40 = the interest for the given time at 6 %.
And $240 + $2.40, or $242.40 = the amount.

25. The time the principal is on interest is 180 da., or 3 × 60 da.

$$\begin{array}{l}\$2.50 = \text{the interest for 60 da. at 6 \%.}\\ \underline{3}\\ \$7.50 = \text{the interest for 180 da. (3 × 60 da.) at 6 \%.}\end{array}$$

∴ $7.50 = the required interest.

And $250 + $7.50, or $257.50 = the required amount.

26. The time the principal is on interest is 90 da., or 60 da. + 30 da.

$0.825 = the interest for 60 da. at 6 %.
$0.4175 = the interest for 30 da. (½ of 60 da.) at 6 %.
$1.2425 = the interest for the given time at 6 %.
∴ $1.24 = the required interest.

And $82.50 + $1.24, or $83.74 = the required amount.

27. The time the principal is on interest is 75 da., or 60 da. + 15 da.

$0.489 = the interest for 60 da. at 6 %.
$0.122¼ = the interest for 15 da. (¼ of 60 da.) at 6 %.
$0.611¼ = the interest for the given time at 6 %.
∴ $0.61 = the required interest.

And $48.91 + $0.61, or $49.51 = the required amount.

28. The time the principal is on interest is 2 yr. 105 da., or 13 × 60 da. + 45 da.

$3.256 = the interest for 60 da. at 6 %.
13
$42.328 = the interest for 2 yr. 60 da. (13 × 60 da.) at 6 %.
$1.628 = the interest for 30 da. (½ of 60 da.) at 6 %.
$0.814 = the interest for 15 da. (¼ of 60 da.) at 6 %.
$44.77 = the interest for the given time at 6 %.
∴ $44.77 = the required interest.

And $325.60 + $44.77, or $370.37 = the required amount.

29. The time the principal is on interest is 100 da., or 1 × 60 da. + 40 da.

$9.275 = the interest for 60 da. at 6 %.
$4.6375 = the interest for 30 da. (½ of 60 da.) at 6 %.
$1.54875 = the interest for 10 da. (⅙ of 60 da.) at 6 %.
$15.46125 = the interest for the given time at 6 %.
∴ $15.46 = the required interest.

And $927.50 + $15.46, or $942.96 = the required amount.

30. The time the principal is on interest is 240 da., or 4 × 60 da.

$2.78 = the interest for 60 da. at 6 %.
4
$11.12 = the interest for 240 da. (4 × 60 da.) at 6 %.
$3.70⅔ = the interest for required time at 2 %.
∴ $7.41⅓ = the interest for required time at 4 %.
∴ $7.41 = the required interest.

And $278 + $7.41, or $285.41 = the required amount.

31. The time the principal is on interest is 300 da., or 5 × 60 da.
$\$0.396$ = the interest for 60 da. at 6 %.
$\underline{\quad\quad 5}$
$\$1.98$ = the interest for 300 da. (5 × 60 da.) at 6 %.
$\underline{\$0.495}$ = the interest for the given time at $1\frac{1}{2}\%$.
∴ $\$1.495$ = the interest for the given time at $4\frac{1}{2}\%$.
∴ $\$1.49$ = the required interest.
And $\$39.60 + \$1.49$, or $\$41.09$ = the required amount.

32. The time the principal is on interest is 126 da., or 2 × 60 da. + 6 da.
$\$0.8294$ = the interest for 60 da. at 6 %.
$\underline{\quad\quad 2}$
$\$1.6588$ = the interest for 120 da. (2 × 60 da.) at 6 %.
$\underline{\$0.08294}$ = the interest for 6 da. ($\frac{1}{10}$ of 60 da.) at 6 %.
$\$1.74174$ = the interest for the given time at 6 %.
$\$0.87087$ = the interest for the given time at 3 %.
∴ $\$0.87$ = the required interest.
And $\$82.94 + \$0.87$, or $\$83.81$ = the required amount.

33. The time the principal is on interest is 200 da., or 3 × 60 da. + 20 da.
$\$1$ = the interest for 60 da. at 6 %.
$\underline{\quad 3}$
$\$3$ = the interest for 180 da. (3 × 60 da.) at 6 %.
$\underline{\$0.33\frac{1}{3}}$ = the interest for 20 da. ($\frac{1}{3}$ of 60 da.) at 6 %.
$\$3.33\frac{1}{3}$ = the interest for the given time at 6 %.
$\underline{\$1.11\frac{1}{9}}$ = the interest for the given time at 2 %.
∴ $\$2.22\frac{2}{9}$ = the interest for the given time at 4 %.
∴ $\$2.22$ = the required interest.
And $\$100 + \$2.22$, or $\$102.22$ = the required amount.

34. The time the principal is on interest is 235 da., or 3 × 60 da. + 55 da.
$\$0.98$ = the interest for 60 da. at 6 %.
$\underline{\quad\quad 3}$
$\$2.94$ = the interest for 180 da. (3 × 60 da.) at 6 %.
$\$0.65\frac{1}{3}$ = the interest for 40 da. ($\frac{2}{3}$ of 60 da.) at 6 %.
$\underline{\$0.24\frac{1}{2}}$ = the interest for 15 da. ($\frac{1}{4}$ of 60 da.) at 6 %.
∴ $\$3.83\frac{5}{6}$ = the interest for the given time at 6 %.
∴ $\$3.84$ = the required interest.
And $\$98 + \$3.84$, or $\$101.84$ = the required amount.

35. The time the principal is on interest is 267 da., or 4×60 da. + 27 da.

$2.0785 = the interest for 60 da. at 6%.

$\underline{\quad\quad 4}$

$8.314 = the interest for 240 da. (4×60 da.) at 6%.

0.6928\frac{1}{3}$ = the interest for 20 da. ($\frac{1}{3}$ of 60 da.) at 6%.

$\underline{\$0.2424\frac{11}{12}}$ = the interest for 7 da. ($\frac{7}{60}$ of 60 da.) at 6%.

∴ 9.2493\frac{1}{4}$ = the interest for the given time at 6%.

1.5415\frac{13}{24}$ = the interest for the given time at 1%.

And 5.780828\frac{1}{8}$ = the interest for the given time at 3$\frac{3}{4}$%.

∴ $5.78 = the required interest.

And $207.85 + $5.78, or $213.63 = the required amount.

36. .04 × $200, or $8 = the interest for 1 year.

120 da., or $\frac{120}{365}$ yr. = the time.

∴ $\frac{120}{365}$ × $8, or $2.63 = the required interest.

37. The time from June 9 to Dec. 15 is 189 da., or $\frac{189}{365}$ yr.

.05 × $678, or $33.90 = the interest for 1 yr.

189 da., or $\frac{189}{365}$ yr. = the time.

∴ $\frac{189}{365}$ × $33.90, or $17.55 = the required interest.

38. The time from Sept. 15 to Dec. 31 is 107 da., or $\frac{107}{365}$ yr.

.06 × $828, or $49.68 = the interest for 1 yr.

107 da., or $\frac{107}{365}$ yr. = the time.

∴ $\frac{107}{365}$ × $49.68, or $14.56 = the required interest.

39. The time from Dec. 1, 1900, to June 15, 1901, is 196 da., or $\frac{196}{365}$ yr.

.045 × $48.25, or $2.17125 = the interest for 1 yr.

196 da., or $\frac{196}{365}$ yr. = the time.

∴ $\frac{196}{365}$ × $2.17125, or $1.17 = the required interest.

40. The time the principal is on interest is 1 yr. 169 da., or 1$\frac{169}{365}$ yr.

.04$\frac{3}{4}$ × $128, or $6.08 = the interest for 1 yr.

∴ 1$\frac{169}{365}$ × $6.08, or $8.90 = the required interest.

41. The time the principal is on interest is 3 yr. 304 da., or 3$\frac{304}{365}$ yr.

.048 × $718, or $34.464 = the interest for 1 yr.

∴ 3$\frac{304}{365}$ × $34.464, or $132.10 = the required interest.

Exercise 109, Page 224.

2. \$0.12 = the interest on \$1 for 1 yr.
\$0.04 = the interest on \$1 for 240 da.
∴ \$0.16 = the interest on \$1 for 1 yr. 240 da., or the given time.
\$32 = the entire interest.
∴ \$32 : \$0.16, or 200 = the number of dollars in the principal.
That is, \$200 = the principal.

3. The time from Feb. 1, 1900, to Feb. 1, 1902, is 2 yr.
The time from Feb. 1, 1901, to July 1, 1902, is
(27 + 31 + 30 + 31 + 30 + 1) da., or 150 da.
∴ the time the principal is on interest = 2 yr. 150 da., or $2\frac{5}{12}$ yr.
\$0.048 = the interest on \$1 for 1 yr.
∴ $2\frac{5}{12}$ × \$0.048, or \$0.116 = the interest on \$1 for the given time.
\$11.60 = the entire interest.
∴ \$11.60 : \$0.116, or 100 = the number of dollars in the principal.
That is, \$100 = the principal.

4. The time the principal is on interest is 2 yr. 91 da., or $2\frac{91}{360}$ yr.
\$0.03 = the interest on \$1 for 1 yr.
∴ $2\frac{91}{360}$ × \$0.03, or \$0.067$\frac{7}{12}$ = the interest on \$1 for the given time.
\$24.30 = the entire interest.
∴ \$24.30 : \$0.067$\frac{7}{12}$, or \$291.60 : \$0.811, or 359.56 = the number of dollars in the principal.
That is, \$359.56 = the principal.

5. The time the principal is on interest is 1 yr. 72 da., or 1.2 yr.
\$0.045 = the interest on \$1 for 1 yr.
∴ 1.2 × \$0.045, or \$0.054 = the interest on \$1 for the given time.
\$18.60 = the entire interest.
∴ \$18.60 : \$0.054, or 344.44 = the number of dollars in the principal.
That is, \$344.44 = the principal.

6. The time the principal is on interest is 228 da., or $\frac{228}{365}$ yr.
\$0.04 = the interest on \$1 for 1 yr.
∴ $\frac{228}{365}$ of \$0.04, or \$0.00$\frac{912}{365}$ = the interest on \$1 for the given time.
\$20 = the entire interest.
∴ \$20 : \$0.00$\frac{912}{365}$, or \$7300 : \$9.12, or 800.44 = the number of dollars in the principal.
That is, \$800.44 = the principal.

7. The time the principal is on interest is 2 yr. 120 da., or $2\frac{1}{3}$ yr.
$0.03 = the interest on $1 for 1 yr.
∴ $2\frac{1}{3}$ × $0.03, or $0.07 = the interest on $1 for the given time.
Then, $1.07 = the amount of $1 for the given time.
$695.50 = the entire amount.
∴ $695.50 : $1.07, or 650 = the number of dollars in the principal.
That is, $650 = the principal.

8. The time the principal is on interest is 2 yr. 92 da.
$0.12 = the interest on $1 for 2 yr.
0.015\frac{1}{3}$ = the interest on $1 for 92 da.
∴ 0.135\frac{1}{3}$ = the interest on $1 for the given time.
Then, 1.135\frac{1}{3}$ = the amount of $1 for the given time.
$1000 = the given amount.
∴ $1000 : 1.135\frac{1}{3}$, or $3000 : 3.406, or 880.80 = the number of dollars in the principal.
That is, $880.80 = the principal.

9. The time the principal is on interest is 219 da., or $\frac{219}{365}$, or $\frac{3}{5}$ yr.
$0.04 = the interest on $1 for 1 yr.
∴ $\frac{3}{5}$ of $0.04, or $0.024 = the exact interest on $1 for the given time.
Then, $1.024 = the amount of $1 for the given time.
∴ $368.64 = the given amount.
∴ $368.64 : $1.024, or 360 = the number of dollars in the principal.
That is, $360 = the principal.

10. The time the principal is on interest is 215 da., or $\frac{43}{73}$ yr.
$0.06 = the interest on $1 for 1 yr.
∴ $\frac{43}{73}$ × $0.06, or 0.035\frac{25}{73}$ = the exact interest of $1 for the time.
And 1.035\frac{25}{73}$ = the amount of $1 for the time.
$1000 = the entire amount.
∴ $1000 : 1.035\frac{25}{73}$, or $965.86 = the number of dollars in the principal.
∴ $965.86 = the required principal.

11. $0.04 = the interest on $1 for 1 yr.
2 yr. 120 da., or $2\frac{1}{3}$ yr. = the time.
∴ $2\frac{1}{3}$ × $0.04, or 0.09\frac{1}{3}$ = the interest on $1 for the time.
And 1.09\frac{1}{3}$ = the amount of $1 for the time.
$262.40 = the entire amount.
∴ $262.40 : 1.09\frac{1}{3}$, or 240 = the number of dollars in the present worth.
And $262.40 – $240, or $22.40 = the true discount.

12. $0.05 = the interest on $1 for 1 yr.
1 yr. 144 da., or $1\frac{2}{5}$ yr. = the time.
∴ $1\frac{2}{5} \times \$0.05$, or $0.07 = the interest on $1 for the time.
And $1.07 = the amount of $1 for the time.
$481.50 = the entire amount.
∴ $481.50 : $1.07, or 450 = the number of dollars in the present worth.
And $481.50 − $450, or $31.50 = the true discount.

13. The time the principal is on interest is 1 yr. 303 da., or $1\frac{101}{120}$ yr.
$0.06 = the interest on $1 for 1 yr.
∴ $1\frac{101}{120} \times \$0.06$, or $0.1105 = the interest on $1 for the time.
And $1.1105 = the amount of $1 for the time.
$1170.50 = the entire amount.
∴ $1170.50 : $1.1105, or $1054.02 = number of dollars in present worth.
And $1170.50 − $1054.02, or $116.48 = the true discount.

14. The time the principal is on interest is 1 yr. 153 da., or $1\frac{51}{120}$ yr.
$0.06 = the interest on $1 for 1 yr.
∴ $1\frac{51}{120} \times \$0.06$, or $0.0855 = the interest on $1 for the time.
And $1.0855 = the amount of $1 for the time.
$2000 = the entire amount.
∴ $2000 : $1.0855, or 1842.47 = number of dollars in present worth.
And $2000 − $1842.47, or $157.63 = the true discount.

Exercise 110, Page 226.

2. .01 of $320, or $3.20 = the interest for 1 yr. at 1%.
1 yr. 72 da., or $1\frac{1}{5}$ yr. = the time.
∴ $1\frac{1}{5} \times \$3.20$, or $3.84 = the interest for the time at 1%.
$17.28 = the given interest.
∴ $17.28 : $3.84, or 4.5 = the required per cent.
That is, $4\frac{1}{2}\%$ = the rate.

3. .01 of $1000, or $10 = the interest for 1 yr. at 1%.
2 yr. 315 da., or $2\frac{63}{72}$ yr. = the time.
∴ $2\frac{63}{72} \times \$10$, or $28.75 = the interest for the time at 1%.
$138 = the given interest.
∴ $138 : $28.75, or 4.8 = the required per cent.
That is, $4\frac{4}{5}\%$ = the rate.

4. .01 of $400, or $4 = the interest for 1 yr. at 1%.
1 yr. 309 da., or $1\frac{103}{120}$ yr. = the time.
∴ $1\frac{103}{120}$ × $4, or 7.43\frac{1}{3}$ = the interest for the time at 1%.
$44.60 = the given interest.
∴ $44.60 : 7.43\frac{1}{3}$, or 6 = the required per cent.
That is, 6% = the rate.

5. The time from July 1 to Sept. 11 is 72 da., or $\frac{1}{5}$ yr.
.01 × $456, or $4.56 = the interest for 1 yr. at 1%.
Then, $\frac{1}{5}$ of $4.56, or $0.912 = the interest for the time at 1%.
$4.56 = the given interest.
∴ $4.56 : $0.912, or 5 = the required per cent.
That is, 5% = the rate.

6. 1 yr. 144 da., or $1\frac{2}{5}$ yr., is the time.
.01 × $278, or $2.78 = the interest for 1 yr. at 1%.
∴ $1\frac{2}{5}$ × $2.78, or $3.892 = the interest for the time at 1%.
$19.46 = the given interest.
∴ $19.46 : $3.892, or 5 = the required per cent.
That is, 5% = the rate.

7. 1 yr. 54 da., or $1\frac{3}{20}$ yr. is the time.
.01 × $100, or $1 = the interest for 1 yr. at 1%.
∴ $1\frac{3}{20}$ × $1, or $1.15 = the interest for the time at 1%.
$104.60 − $100, or $4.60 = the entire interest.
∴ $4.60 : $1.15, or 4 = the required per cent.
That is, 4% = the rate.

8. The time from Dec. 1, 1901, to March 1, 1902, is 90 da., or $\frac{1}{4}$ yr.
.01 × $425, or $4.25 = the interest for 1 yr. at 1%.
∴ $\frac{1}{4}$ × $4.25, or $1.0625 = the interest for the time at 1%.
$446.25 − $425, or $21.25 = the entire interest.
∴ $21.25 : $1.0625, or 20 = the required per cent.
That is, 20% = the rate.

9. 315 da., or $\frac{63}{72}$ yr., is the time.
.01 of $400, or $4 = the interest for 1 yr. at 1%.
∴ $\frac{63}{72}$ × $4, or $3.50 = the interest for the time at 1%.
$416.80 − $400, or $16.80 = the interest.
∴ $16.80 : $3.50, or 4.8 = the required per cent.
That is, 4.8% = the rate.

10. 146 da., or $\frac{146}{365}$ yr., is the time.
.01 of $500, or $5 = the interest for 1 yr. at 1%.

∴ $\frac{146}{365}$ × $5, or $2 = the interest for the time at 1%.
$508 − $500, or $8 = the entire interest.
∴ $8 : $2, or 4 = the required per cent.
That is, 4% = the rate.

11. 219 da., or $\frac{3}{5}$ yr., is the time.
.01 of $240, or $2.40 = the interest for 1 yr. at 1%.
∴ $\frac{3}{5}$ × $2.40, or $1.44 = the interest for the time at 1%.
$244.32 − $240, or $4.32 = the entire interest.
∴ $4.32 : $1.44, or 3 = the required per cent.
That is, 3% = the rate.

13. 200% of the principal = the required amount.
100% of the principal = the principal.
∴ 100% of the principal = the interest.
15% of the principal = the interest for 15 yr. at 1%.
∴ 100% of the principal : 15% of the principal, or 6$\frac{2}{3}$ = the required per cent.
That is, 6$\frac{2}{3}$% = the rate.

14. 100% of the principal = the principal.
200% of the principal = the interest.
50% of the principal = the interest for 50 yr. at 1%.
∴ 200% of the principal : 50% of the principal, or 4 = the required per cent.
That is, 4% = the rate.

15. 250% of the principal = the required amount.
100% of the principal = the principal.
∴ 150% of the principal = the interest.
25% of the principal = the interest for 25 yr. at 1%.
∴ 150% of the principal : 25% of the principal, or 6 = the required per cent.
That is, 6% = the rate.

Exercise 111, Page 227.

2. .04$\frac{1}{2}$ of $500, or $22.50 = the interest for 1 yr.
$72 = the entire interest.
∴ $72 : $22.50, or 3.2 = the number of years.
.2 yr. = .2 of 360 da., or 72 da.
∴ 3 yr. 72 da. = the required time.

3. .04⅘ of $1000, or $48 = the interest for 1 yr.
$138 = the entire interest.
∴ $138 : $48, or 2.8¾ = the number of years.
.8¾ yr. = .8¾ of 360 da., or 315 da.
∴ 2 yr. 315 da. = the required time.

4. .04 of $200, or $8 = the interest for 1 yr.
$208 − $200, or $8 = the entire interest.
∴ $8 : $8, or 1 = the number of years.
∴ 1 yr. = the required time.

5. .04 of $425, or $17 = the interest for 1 yr.
$446.25 − $425, or $21.25 = the entire interest.
∴ $21.25 : $17, or 1.25 = the number of years.
.25 yr. = .25 of 360 da., or 90 da.
∴ 1 yr. 90 da. = the required time.

6. .06 of $250, or $15 = the interest for 1 yr.
$300 − $250, or $50 = the entire interest.
∴ $50 : $15, or 3⅓ = the number of years.
⅓ yr. = ⅓ of 360 da., or 120 da.
∴ 3 yr. 120 da. = the required time.

7. .04½ of $200, or $9 = the interest for 1 yr.
$300 − $200, or $100 = the entire interest.
∴ $100 : $9, or 11⅑ = the number of years.
⅑ yr. = ⅑ of 360 da., or 40 da.
∴ 11 yr. 40 da. = the required time.

8. .04½ × $320, or $14.40 = the interest for 1 yr.
$337.28 − $320, or $17.28 = the entire interest.
∴ $17.28 : $14.40, or 1.2 = the number of years.
.2 of a year = .2 of 360 da., or 72 da.
∴ 1 yr. 72 da. = the required time.
March 1, 1900 + 1 yr. = March 1, 1901.
March 1, 1901 + 72 da., or May 12, 1901 = the required date.

9. .04⅘ of $400, or $19.20 = the interest for 1 yr.
$416.80 − $400, or $16.80 = the entire interest.
∴ $16.80 : $19.20, or ⅞ = the number of years.
⅞ yr. = ⅞ of 360 da., or 315 da.
∴ 315 da. = the required time.
Jan. 2 + 315 da., or Nov. 13 = the required date.

10. .04 of $1000, or $40 = the interest for 1 yr.
$1060 − $1000, or $60 = the entire interest.
∴ $60 : $40, or 1.5 = the number of years.
.5 of a year = .5 of 360 da., or 180 da.
∴ 1 yr. 180 da. = the required time.
May 1, 1901 + 1 yr. = May 1, 1902.
May 1, 1902 + 180 da., or Oct. 28, 1902 = the required date.

11. .04 of $500, or $20 = the interest for 1 yr.
$8 = the entire interest.
∴ $8 : $20, or $\frac{2}{5}$ = the number of years.
$\frac{2}{5}$ of a year = $\frac{2}{5}$ of 365 da., or 146 da.
∴ 146 da. is the required time.
March 1 + 146 da., or July 26 = the required date.

13. 200% of the principal = the required amount.
100% of the principal = the principal.
∴ 100% of the principal = the interest.
3½% of the principal = the interest for 1 yr. at 3½%.
∴ 100% of the principal : 3½% of the principal, or 28$\frac{4}{7}$ = the number of years.
∴ 28$\frac{4}{7}$ yr. = the required time.

14. 150% of the principal = the required interest.
100% of the principal = the principal.
4½% of the principal = the interest for 1 yr. at 4½%.
∴ 150% of the principal : 4½% of the principal, or 33⅓ = number of years.
∴ 33⅓ yr. = the required time.

15. 175% of the principal = the required amount.
100% of the principal = the principal.
∴ 75% of the principal = the interest.
6% of the principal = the interest for 1 yr. at 6%.
∴ 75% of the principal : 6% of the principal, or 12½ = the number of years.
∴ 12½ yr. = the required time.

Exercise 112, Page 229.

6. $100 = the par value of 1 share.
⅛% of $100, or $0.125 = the brokerage on 1 share.
136⅜% of the par value = the market value.

∴ 136⅜% of $100, or $136.375 = the market value of 1 share.
$136.375 + $0.125, or $136.50 = the entire cost of 1 share.
And 10 × $136.50, or $1365 = the entire cost of 10 shares.

7. $100 = the par value of 1 share.
⅛% of $100, or $0.12½ = the brokerage on 1 share.
158½% of the par value = the market value.
∴ 158½% of $100, or $158.50 = the market value of 1 share.
$158.50 + $0.125, or $158.625 = the entire cost of 1 share.
And 15 × $158.625, or $2379.38 = the entire cost of 15 shares.

8. $50 = the par value of 1 share.
⅛% of $50, or $0.0625 = the brokerage on 1 share.
197% of the par value = the market value.
∴ 197% of $50, or $98.50 = the market value of 1 share.
$98.50 + $0.0625, or $98.5625 = the entire cost of 1 share.
And 25 × $98.5625, or $2464.06 = the entire cost of 25 shares.

9. $50 = the par value of 1 share.
¼% of $50, or $0.125 = the brokerage on 1 share.
$34⅝ = the market value of 1 share.
∴ $34⅝ + $0.12½, or $34.75 = the entire cost of 1 share.
And 20 × $34.75, or $695 = the entire cost of 20 shares.

10. $100 = the par value of 1 bond.
114% of $100, or $114 = the market value of 1 bond.
⅛% of $100, or $0.125 = the brokerage on 1 bond.
∴ $114 + $0.125, or $114.125 = the entire cost of 1 bond.
And 4 × $114.125, or $456.50 = the entire cost of 4 bonds.

11. $50 = the par value of 1 bond.
110% of $50, or $55 = the market value of 1 bond.
⅛% of $50, or $0.0625 = the brokerage on 1 bond.
∴ $55 + $0.0625, or $55.0625 = the entire cost of 1 bond.
And 3 × $55.0625, or $165.19 = the entire cost of 3 bonds.

12. $100 = the par value of 1 share.
93⅜% of $100, or $93.375 = the market value of 1 share.
⅛% of $100, or $0.125 = the brokerage on 1 share.
∴ $93.375 − $0.125, or $93.25 = the net proceeds of 1 share.
And 60 × $93.25, or $5595 = the net proceeds of 60 shares.

13. $100 = the par value of 1 share.
58½% of $100, or $58.50 = the market value of 1 share.

⅛ % of $100, or $0.125 = the brokerage on 1 share.
∴ $58.50 − $0.125, or $58.375 = the proceeds of 1 share.
And 200 × $58.375, or $11675 = the proceeds of 200 shares.

14. $50 = the par value of 1 share.
$68 = the market value of 1 share.
⅛ % of $50, or $0.0625 = the brokerage on 1 share.
∴ $68 − $0.0625, or $67.9375 = the net proceeds of 1 share.
And 10 × $67.9375, or $679.38 = the proceeds of 10 shares.

15. $50 = the par value of 1 share.
116 % of $50, or $58 = the market value of 1 share.
⅛ % of $50, or $0.0625 = the brokerage on 1 share.
∴ $58 − $0.0625, or $57.9375 = the proceeds of 1 share.
And 20 × $57.9375, or $1158.75 = the proceeds of 20 shares.

16. $1000 = the par value of 1 bond.
111¾ % of $1000, or $1117.50 = the market value of 1 bond.
⅛ % of $1000, or $1.25 = the brokerage on 1 bond.
∴ $1117.50 − $1.25, or $1116.25 = the proceeds of 1 bond.
And 6 × $1116.25, or $6697.50 = the proceeds of 6 bonds.

17. $100 = the par value of 1 share.
112½ % of $100, or $112.50 = the market value of 1 share.
$0.125 = the brokerage on 1 share.
∴ $112.625 = the entire cost of 1 share.
$1126.25 = the entire cost of the stock.
∴ $1126.25 : $112.625, or 10 = the number of shares.

18. $50 = the par value of 1 share.
108½ % of $50, or $54.25 = market value of 1 share.
$0.0625 = the brokerage on 1 share.
∴ $54.3125 = the entire cost of 1 share.
$2000 = the entire cost of the stock.
∴ $2000 : $54.3125, or 36 = the number of shares, with a surplus of $44.75.

19. $50 = the par value of 1 share.
$67.50 = the market value of 1 share.
$0.125 = the brokerage on 1 share.
∴ $67.625 = the entire cost of 1 share.
$2500 = the entire cost of the stock.
∴ $2500 : $67.625, or 36 = the number of shares, with a surplus of $65.50.

20. $ 100 = the par value of 1 bond.
114½ % of $ 100, or $ 114.50 = the market value of 1 bond.
$ 0.125 = the brokerage on 1 bond.
∴ $ 114.625 = the entire cost of 1 bond.
$ 10000 = the entire cost of all the bonds.
∴ $ 10000 : $ 114.625, or 87 = the number of bonds, with a surplus of $ 27.625.

21. $ 100 = the par value of 1 bond.
110½ % of $ 100, or $ 110.50 = the market value of 1 bond.
$ 0.125 = the brokerage on 1 bond.
∴ $ 110.375 = the net proceeds of 1 bond.
$ 2207.50 = the entire proceeds.
∴ $ 2207.50 : $ 110.375, or 20 = the number of bonds.
And 20 × $ 100, or $ 2000 = the amount of bonds.

22. $ 50 = the par value of 1 share.
$ 62.50 = the market value of 1 share.
$ 0.125 = the brokerage on 1 share.
∴ $ 62.375 = the net proceeds of 1 share.
$ 499 = the entire proceeds.
∴ $ 499 : $ 62.375, or 8 = the number of shares.

23. $ 100 = the par value of 1 bond.
105¼ % of $ 100, or $ 105.25 = the market value of 1 bond.
$ 0.125 = the brokerage on 1 bond.
∴ $ 105.125 = the net proceeds of 1 bond.
$ 2000 = the proceeds required.
∴ $ 2000 : $ 105.125, or 19 = the number of bonds, with a deficit of $ 2.625.
∴ 20 bonds must be sold, and the surplus will be $ 102.50.

24. $ 6000 = the par value of the bonds.
4 % of the par value = the annual income.
∴ 4 % of $ 6000, or $ 240 = the annual income.

25. $ 50 = the par value of 1 bond.
3 % of the par value = the annual income.
∴ 3 % of $ 50, or $ 1.50 = the annual income on 1 bond.
And 20 × $ 1.50, or $ 30 = the annual income on 20 bonds.

26. $ 100 = the par value of 1 bond.
∴ 5 % of $ 100, or $ 5 = the annual income on 1 bond.
And 10 × $ 5, or $ 50 = the annual income on 10 bonds.

27. $4000 = the par value of the stock.
∴ 30% of $4000, or $1200 = the annual dividend.

28. $100 = the par value of 1 share.
∴ 6% of $100, or $6 = the annual dividend on 1 share.
And 20 × $6, or $120 = the annual dividend on 20 shares.

29. $50 = the par value of 1 share.
∴ 4% of $50, or $2 = the annual dividend of 1 share.
And 50 × $2, or $100 = the annual dividend of 50 shares.

30. $50 = the par value of 1 share.
∴ 2½% of $50, or $1.25 = the semi-annual dividend of 1 share.
And 2 × $1.25, or $2.50 = the annual dividend of 1 share.
Whence, 10 × $2.50, or $25 = the annual dividend of 10 shares.

31. $100 = the par value of 1 share.
128¼% of the par value = the market value.
128¼% of $100, or $128.25 = the market value of 1 share.
$0.125 = the brokerage on 1 share.
And $128.375 = the entire cost of 1 share.
Whence, 20 × $128.375, or $2567.50 = the entire cost of 20 shares.
156% of $100, or $156 = the market value of 1 share when sold.
$0.125 = the brokerage on 1 share.
∴ $155.875 = the net proceeds of 1 share.
And 20 × $155.875, or $3117.50 = the proceeds of 20 shares.
∴ $3117.50 − $2567.50, or $550 = the gain.

32. $100 = the par value of 1 bond.
$0.125 = the brokerage on 1 bond.
∴ $100.125 = the entire cost of 1 bond.
And 20 × $100.125, or $2002.50 = the entire cost of 20 bonds.
110½% of $100, or $110.50 = the market value of 1 bond when sold.
$0.125 = the brokerage on 1 bond.
∴ $110.375 = the proceeds of 1 bond.
And 20 × $110.375, or $2207.50 = the proceeds of 20 bonds.
∴ $2207.50 − $2002.50, or $205 = the gain.

33. $50 = the par value of 1 share.
$65.125 = the market value of 1 share.
$0.125 = the brokerage on 1 share.
∴ $65.25 = the entire cost of 1 share.
And 6 × $65.25, or $391.50 = the entire cost of 6 shares.
$74.125 = the market value of 1 share when sold.

$0.125 = the brokerage on 1 share.
∴ $74 = the proceeds of 1 share.
And 6 × $74, or $444 = the proceeds of 6 shares.
∴ $444 – $391.50, or $52.50 = the gain.

34. $50 = the par value of 1 share.
∴ 5% of 50, or $2.50 = the annual dividend on 1 share.
$620 = the entire dividend.
∴ $620 : $2.50, or 248 = the number of shares.

35. $50 = the par value of 1 share.
∴ 4% of $50, or $2 = the semi-annual dividend on 1 share.
And 2 × $2, or $4 = the annual dividend on 1 share.
$80 = the entire annual dividend.
∴ $80 : $4, or 20 = the number of shares.

36. $100 = the par value of 1 share.
∴ 4% of $100, or $4 = the dividend on 1 share.
$96 = the entire dividend.
∴ $96 : $4, or 24 = the number of shares.
113½% of $100, or $113.50 = the market value on 1 share.
$0.125 = the brokerage on 1 share.
∴ $113.625 = the entire cost of 1 share.
And 24 × $113.625, or $2727 = the sum to be invested.

37. $100 = the par value of 1 share.
∴ 4% of $100, or $4 = the dividend on 1 share.
$220 = the entire dividend.
∴ $220 : $4, or 55 = the number of shares.
108¼% of $100, or $108.25 = the market value of 1 share.
$0.125 = the brokerage on 1 share.
∴ $108.375 = the entire cost of 1 share.
And 55 × $108.375, or $5960.625, or $5960.63 = the sum to be invested.

38. $50 = the par value of 1 share.
∴ 2½% of $50, or $1.25 = the semi-annual dividend on 1 share.
And 2 × $1.25, or $2.50 = the annual dividend on 1 share.
$100 = the entire dividend.
∴ $100 : $2.50, or 40 = the number of shares.
$74.125 = the market value of 1 share.
$0.125 = the brokerage on 1 share.
∴ $74.25 = the entire cost of 1 share.
And 40 × $74.25, or $2970 = the entire cost of 40 shares.

39. $100 = the par value of 1 share.
137% of $100, or $137 = the market value of 1 share.
$0.125 = the brokerage on 1 share.
∴ $137.125 = the entire cost of 1 share.
$1097 = the entire cost of the stock.
∴ $1097 : $137.125, or 8 = the number of shares.
And 8 × $100 or $800 = the par value of the stock.
4% of the par value = the dividend.
∴ 4% of $800, or $32 = the dividend.

40. $50 = the par value of 1 share.
$74 = the market value of 1 share.
$0.125 = the brokerage on 1 share.
∴ $74.125 = the entire cost of 1 share.
$7412.50 = the entire cost of the stock.
∴ $7412.50 : $74.125, or 100 = the number of shares.
And 100 × $50 or $5000 = the par value of the stock.
∴ 5½% of $5000 or $275 = the dividend.

41. $50 = the par value of 1 share.
120% of $50, or $60 = the market value of 1 share.
$0.0625 = the brokerage on 1 share.
∴ $60.0625 = the entire cost of 1 share.
$6006.25 = the entire cost of the stock.
∴ $6006.25 : $60.0625, or 100 = the number of shares.
And 100 × $50, or $5000 = the par value of the stock.
∴ 4% of $5000, or $200 = the dividend.

42. $100 = the par value of 1 share.
∴ 6% of $100, or $6 = the annual dividend on 1 share.
124¾% of $100, or $124.75 = the market value of 1 share.
$0.125 = the brokerage on 1 share.
∴ $124.875 = the entire cost of 1 share.
.01 × $124.875 or $1.24875 = the income, if the rate were 1%.
But, $6 = the income.
∴ $6 : $1.24875, or 4.80 = the required per cent.
That is, 4.80% = the required rate of income.

43. $100 = the par value of 1 share.
∴ 5% of $100, or $5 = the dividend on 1 share.
119⅞% of $100, or $119.875 = the market value of 1 share.

⅛% of $100, or $0.125 = the brokerage on 1 share.
∴ $120 = the entire cost of 1 share.
.01 × $120, or $1.20 = the income, if the rate were 1%.
∴ $5 : $1.20, or 4.17 = the required per cent.
That is, 4.17% = the rate of income.

44. $100 = the par value of 1 share.
∴ 4% of $100, or $4 = the dividend on 1 share.
114⅞% of $100, or $114.875 = the market value of 1 share.
⅛% of $100 or $0.125 = the brokerage on 1 share.
∴ $115 = the entire cost of 1 share.
.01 × $115 or $1.15 = the income, if the rate were 1%.
∴ $4 : $1.15, or 3.48 = the required per cent.
That is, 3.48% = the required rate of income.

45. $50 = the par value of 1 share.
∴ 4% of $50, or $2 = the dividend on 1 share.
112½% of $50, or $56.25 = the market value of 1 share.
⅛% of $50, or $0.0625 = the brokerage on 1 share.
∴ $56.3125 = the entire cost of 1 share.
And .01 × $56.3125, or $0.563125 = the income, if the rate were 1%.
∴ $2 : $0.563125, or 3.55 = the required per cent.
That is, 3.55% = the required rate of income.

46. $50 = the par value of 1 share.
∴ 2½% of $50, or $1.25 = the semi-annual dividend on 1 share.
And 2 × $1.25, or $2.50 = the annual dividend on 1 share.
$74 = the market value of 1 share.
¼% of $50, or $0.125 = the brokerage on 1 share.
∴ $74.125 = the entire cost of 1 share.
And .01 × $74.125, or $0.74125 = the income, if the rate were 1%.
∴ $2.50 : $0.74125, or 3.37 = the required per cent.
That is, 3.37% = the required rate of income.

47. $100 = the par value of 1 share.
∴ 6% of $100, or $6 = the dividend on 1 share.
But, 5% of the investment = the dividend.
∴ 5% of the investment = $6.
Whence, 1% of the investment = ⅕ of $6, or $1.20.
And 100% of the investment = 100 × $1.20, or $120.

Exercise 113, Page 235.

2. 1 yr. 6 mo. = 3 semi-annual periods.
3% = the semi-annual rate.
$1.092727 = the compound amount of $1 for 3 periods at 3%.
∴ 500 × $1.092727, or $546.36 = the compound amount of $500.
And $546.36 − $500, or $46.36 = the compound interest.

3. $1.262477 = the compound amount of $1 for 4 yr. at 6%.
∴ 300 × $1.262477, or $378.7431, or $378.74 = the compound amount of $300.
And $378.74 − $300, or $78.74 = the compound interest.

4. $400 = the principal.
.045 × $400, or $18 = the interest for the first year.
Then, $400 + $18, or $418 = the new principal to start second year.
.045 × $418, or $18.81 = the interest for the second year.
Then, $418 + $18.81, or $436.81 = the new principal for third year.
.045 × $436.81, or $19.63645 = the interest for the third year.
Then, $436.81 + $19.63645, or $456.47 = the compound amount of $400.
Whence, $456.47 − $400, or $56.47 = the compound interest.

5. $1.108718 = the compound amount of $1 for 3 yr. at 3½%.
∴ 375 × $1.108718, or $415.77 = the compound amount of $375.
And $415.77 − $375, or $40.77 = the compound interest.

6. $1.131408 = the compound amount of $1 for 5 yr. at 2½%.
∴ 2000 × $1.131408, or $2262.82 = the compound amount of $2000.
And $2262.82 − $2000, or $262.82 = the compound interest.

7. 2 yr. = 4 semi-annual periods.
2½% = the semi-annual rate.
$1.103813 = the compound amount of $1 for 4 periods at 2½%.
∴ 500 × $1.103813, or $551.91 = the compound amount of $500.
And $551.91 − $500, or $51.91 = the compound interest.

8. 2½ yr. = 5 semi-annual periods.
3% = the semi-annual rate.
$1.159274 = the compound amount of $1 for 5 periods at 3%.
∴ 300 × $1.159274, or $347.78 = the compound amount of $300.
And $347.78 − $300, or $47.78 = the compound interest.

9. 1 yr. = 4 quarterly periods.
1¼% = the quarterly rate.
$1.05094533 = the compound amount of $1 for 4 periods at 1¼%.
∴ 500 × $1.05094533, or $525.47 = the compound amount of $500.
And $525.47 − $500, or $25.47 = the compound interest.

10. 9 mo. = 3 quarterly periods.
1½% = the quarterly rate.
$1.045678 = the compound amount of $1 for 3 periods at 1½%.
∴ 500 × $1.045678, or $522.84 = the compound amount of $500.
And $522.84 − $500, or $22.84 = the compound interest.

11. 1 yr. 3 mo. = 5 quarterly periods.
2% = the quarterly rate.
$1.104081 = the compound amount of $1 for 5 periods at 2%.
∴ 1000 × $1.104081, or $1104.08 = the compound amount of $1000.
And $1104.08 − $1000, or $104.08 = the compound interest.

12. 4 yr. 6 mo. = 9 semi-annual periods.
2½% = the semi-annual rate.
$1.248863 = the compound amount of $1 for 9 periods at 2½%.
∴ 3000 × $1.248863, or $3746.59 = the compound amount of $3000.
And $3746.59 − $3000, or $746.59 = the compound interest.

13. 4 yr. 6 mo. = 9 semi-annual periods.
2½% = the semi-annual rate.
$1.248863 = the compound amount of $1 for 9 periods at 2½%.
∴ 840 × $1.248863, or $1049.04 = the compound amount of $840.
And $1049.04 − $840, or $209.04 = the compound interest.

14. 4 yr. 6 mo. = 18 quarterly periods.
1% = the quarterly rate.
$1.19614747 = the compound amount of $1 for 18 periods at 1%.
∴ 2000 × $1.19614747, or $2392.29 = the compound amount of $2000.
And $2392.29 − $2000, or $392.29 = the compound interest.

15. 3 yr. 6 mo. = 7 semi-annual periods.
1½% = the semi-annual rate.
$1.109845 = the compound amount of $1 for 7 periods at 1½%.
$11098.45 = the entire amount.
∴ $11098.45 : $1.109845, or 10000 = the number of dollars in the principal.
∴ $10000 = the principal.

16. $1.340096 = the compound amount of $1 for 6 yr. at 5%.
$4020.288 = the entire amount.
∴ $4020.288 : $1.340096, or 3000 = the number of dollars in the principal.
∴ $3000 = the principal.

17. $1.898299 = the compound amount of $1 for 11 yr. at 6%.
$7593.196 = the entire amount.
∴ $7593.196 : $1.898299, or 4000 = the number of dollars in the principal.
∴ $4000 = the principal.

18. 3 yr. 6 mo. = 7 semi-annual periods.
2½% = the semi-annual rate.
$1.188686 = the compound amount of $1 for 7 periods at 2½%.
$29717.15 = the entire amount.
∴ $29717.15 : $1.188686, or 25000 = the number of dollars in the principal.
∴ $25000 = the principal.

19. 4 yr. 9 mo. = 19 quarterly periods.
¾% = the quarterly rate.
$1.15254009 = the compound amount of $1 for 19 periods at ¾%.
$48406683.78 = the entire amount.
∴ $48406683.78 : $1.15254009, or 42000000 = the number of dollars in the principal.
∴ $42000000 = the principal.

Exercise 114, Page 240.

1. In Form 1, see § 297. In Form 2, the makers are S. B. Sellers and W. W. Kurtz, and the payee I. B. Wicker. In Form 3, the maker is M. J. Eckels, and the payee J. P. Brant.

2. In Form 1, James Osborn. In Form 2, S. B. Sellers, or, if he is unable to pay the note, W. W. Kurtz. In Form 3, M. J. Eckels.

3. June 30, 1899.

4. Feb. 15, 1902 ; 276 da.

5. July 15, 1899.

6.

$10.00. (Place), June 3, 1901.

Ninety days after date I promise to pay to the order of L. B. Wells, at

The First National Bank,

Ten$\frac{00}{100}$ ———————————— Dollars

Without defalcation. Value received.

(Your Name).

7. L. B. Wells; or, Pay to the order of R. M. Simpson.

R. B. Wells.

See Indorsements, pp. 239, 240.

8. (Place), Sept. 20, 1901.

Nine months after date, I promise to pay to the order of S. L. Jamison, at

(Name of Bank),

Ninety$\frac{00}{100}$ ———————————— Dollars

Without defalcation. Value received.

(Your Name).

R. M. White.

10.

50\frac{00}{100}$. (Place), Jan. 16, 1901.

Ninety days after date, I promise to pay to the order of S. R. Miller, at

(Name of Bank),

Fifty$\frac{00}{100}$ ———————————— Dollars

Without defalcation. Value received. (Your Name).

11. The maker is L. J. Driggs, and the payee William P. Davis. Jan. 30, 1902. $228.48. L. J. Driggs. L. J. Driggs.

12. The note matures Oct. 1, 1901, and is on interest 183 da. The interest due is $5.49.

13. The legal rate in Delaware is 6%. See p. 248. The note is on interest for 90 da., and the interest due at maturity is $3.

∴ $203 = the amount due at maturity.

14. The payee of a note is always the first indorser. Since the payee is supposed to indorse this note and give it to the maker, the maker should indorse it after the payee. See § 300, p. 237.

Exercise 115, Page 245.

1. Charles Harding. M. S. Taylor. The draft is due whenever the holder presents it for payment. M. S. Taylor.

2. Use Form 4, p. 242, making yourself drawer, B payee, A drawee, and $50 the face. Date the draft appropriately.

3. J. P. Edge. A. B. Maynard. A. H. Hartman. 60 da. after Feb. 17, 1901, or April 18, 1901. A. B. Maynard. A. B. Maynard.

4. Use Form 5, p. 243. The draft is due 30 da. after acceptance, or Oct. 5, 1901. L. J. Harman, the drawee, should pay the draft when due. In states where "grace" is allowed, the draft is due Oct. 8, 1901.

5. Use Form 5, writing *Sixty days after date* instead of *At sixty days' sight.* Make yourself drawer, O. B. Manley payee, S. B. Brooks drawee, and $75 the face. For manner of accepting a draft payable *after date*, see p. 243, § 307, 2.

6. The drawer is John Wanamaker, the drawee E. A. Prince, and the payee John Wanamaker. The draft is due whenever presented for payment to E. A. Prince. E. A. Prince pays the draft when presented to him and receives the draft.

7. Use Form 6, p. 243. Make *self* payee, S. R. Roberts drawee, and sign your own name as drawer. Make the face of the draft $25; date the draft appropriately. See p. 244, § 308, for explanation of the steps to be taken to collect the draft.

8. The drawer is A. S. Harkness, the payee Evan Ambler, and the drawee the Hanover National Bank. The Quarryville National Bank has deposits in the Hanover National Bank.

The indorsements that would appear are as follows:

Pay to the order of M. R. Walton.
Evan Ambler.
M. R. Walton.

9. Use Form 7, p. 244, writing, instead of *Quarryville National Bank*, *Farmers' National Bank;* instead of *Evan Ambler*, *William Price;* instead of *Hanover National Bank*, *Girard National Bank.* Supply any name for the name of the cashier of the Farmers' National Bank. See explanation following Form 7, p. 244, of how the draft can be used to pay the debt. Notice that C. J. Allen's name should not appear on the face of the draft; the draft should be indorsed to him by William Price.

11. The drawer is Wm. S. Delp; the drawee, The National Bank of Chester County; the payee, Wallace P. Dick. The check is payable whenever presented at the bank. Wm. S. Delp is a depositor. Wallace P. Dick receives the sum mentioned in the face; he may receive this sum from any one that is willing to cash the check. Wm. S. Delp finally receives the check from the bank and holds it. The check must be indorsed before it is cashed; the payee is always the first indorser.

12. Use Form 8, page 245. Make yourself drawer, the bank drawee, and Frank Hartman payee.

13. Use Form 8, page 245. Make yourself payee, the Commonwealth National Bank drawee, and James Manley drawer. The draft should be dated where the bank is located. Write your name on the back of the draft and after your name, *Wm. Brown.* Indorsements may be written anywhere on the back of the paper, but it is customary and proper to write them across the top of the back, which is the left-hand end of the face.

14.

James Hammond

(Your name)

Exercise 116, Page 249.

2. 60 da. after June 1, 1901, or July 31, 1901 = the date of maturity.
June 2, 1901 = the date of discount.
∴ 29 da. + 31 da., or 60 da. = the time of discount.
6% = the legal rate of discount in Pennsylvania.
$5 = the discount on $500 for 60 da.
And $500 − $5, or $495 = the proceeds.

3. 60 da. after March 10, 1901, or May 9, 1901 = date of maturity.
March 10, 1901 = the date of discount.
∴ 21 da. + 30 da. + 9 da., or 60 da. = the time of discount.
6% = the legal rate of discount in New Jersey.
$6 = the discount on $600 for 60 da.
And $600 − $6, or $594 = the proceeds.

4. 9 mo. after July 5, 1901, or April 5, 1902 = date of maturity.

Aug. 10, 1901 = the date of discount.

∴ 22 da. + 30 da. + 31 da. + 30 da. + 31 da. + 31 da. + 28 da. + 31 da. + 5 da., or 239 da., or $\frac{239}{360}$ yr. = time of discount.

6 % = the legal rate of discount in Pennsylvania.

$ 27 = the discount on $ 450 for 1 yr.

∴ $\frac{239}{360} \times$ $ 27, or $ 17.925 = the discount on $ 450 for 239 da.

And $ 450 – $ 17.925, or $ 432.08 = the proceeds.

5. 30 da. after May 2, 1901, or June 1, 1901 = date of maturity.

May 2, 1901 = the date of discount.

∴ 29 da. + 1 da., or 30 da. = the time of discount.

6 % = the legal rate of discount in New York.

$ 2 = the discount on $ 200 for 60 da.

∴ $\frac{1}{2}$ of $ 2, or $ 1 = the discount on $ 200 for 30 da.

And $ 200 – $ 1, or $ 199 = the proceeds.

6. 90 da. after Sept. 15, 1901, or Dec. 14, 1901 = date of maturity.

Sept. 30, 1901 = the date of discount.

∴ 1 da. + 31 da. + 30 da. + 14 da., or 76 da., or $\frac{19}{90}$ yr. = the time of discount.

6 % = the legal rate of discount in Maryland.

∴ .06 × $ 240, or $ 14.40 = the discount on $ 240 for 1 yr.

Then $\frac{19}{90} \times$ $ 14.40, or $ 3.04 = the discount on $ 240 for 76 da.

And $ 240 – $ 3.04, or $ 237.96 = the proceeds.

7. Jan. 2, 1902 = the date of maturity.

Sept. 1, 1901 = the date of discount.

∴ 30 da. + 31 da. + 30 da. + 31 da. + 2 da., or 124 da., or $\frac{31}{90}$ yr. = the time of discount.

6 % = the legal rate of discount in Delaware.

$ 12 = the discount on $ 200 for 1 yr.

∴ $\frac{31}{90} \times$ $ 12, or $ 4.13 = the discount on $ 200 for 124 da.

And $ 200 – $ 4.13, or $ 195.87 = the proceeds.

8. 6 mo. after Sept. 19, 1899, or March 19, 1900 = the date of maturity.

181 da. (Sept. 19, 1899–March 19, 1900) = the time the note bears interest.

.05 of $ 240, or $ 12 = the interest on $ 240 for 1 yr.

∴ $\frac{181}{360}$ of $ 12, or $ 6.03 = the interest on the note to maturity.

And $240 + $6.03, or $246.03 = the amount of the note at maturity.
Jan. 2, 1900, is the date of discount.
∴ 77 da. (Jan. 2–March 19) = the time of discount.
.06 of $246.03, or $14.76 = the discount on the amount for 1 yr.
∴ $\frac{77}{360}$ of $14.76, or $3.16 = the discount on the amount for 77 da.
And $246.03 – $3.16, or $242.87 = the proceeds.

9. $\frac{1}{4}$ of .045 × $500, or $5.625 = the interest on the note for 90 da.
Then $505.625 = the amount of the note at maturity.
91 da. = the time of discount [§ 312, 2].
.06 of $505.625, or $30.3375 = the discount on the amount for 1 yr.
∴ $\frac{91}{360}$ of $30.3375, or $7.668 = the discount on the amount for 91 da.
And $505.625 – $7.668, or $497.96 = the proceeds.

10. 6 mo. after Jan. 5, 1901, or July 5, 1901 = the date of maturity.
181 da. (Jan. 5, 1901–July 5, 1901) = the time the note bears interest.
.06 of $150, or $9 = the interest on $150 for 1 yr.
∴ $\frac{181}{360}$ of $9, or $4.525 = the interest on the note to maturity.
And $154.525 = the amount of the note at maturity.
Jan. 5, 1901, is the date of discount.
∴ 182 da. (Jan. 5–July 5) = the time of discount [§ 312, 2].
.06 of $154.525, or $9.2715 = the discount on the amount for 1 yr.
∴ $\frac{182}{360}$ of $9.2715, or $4.689 = the discount on the amount for 182 da.
And $154.525 – $4.689, or $149.84 = the proceeds.

11. 90 da. after Sept. 12, 1899, or Dec. 11, 1899 = the date of maturity.
90 da. = the time the note bears interest.
∴ $\frac{1}{4}$ of .06 × $348, or $5.22 = the interest on the note to maturity.
Then, $353.22 = the amount of the note at maturity.
Sept. 12, 1899 is the date of discount.
90 da. = the time of discount.
∴ $\frac{1}{4}$ of .06 × $353.22, or $5.2983 = the discount on the amount.
And $353.22 – $5.2983, or $347.92 = the proceeds.

13. 60 da. after June 1, 1901, or July 31, 1901 = date of maturity.
June 1, 1901 = the date of discount.
∴ 30 da. + 31 da., or 61 da. = the term of discount.
0.010\frac{1}{6}$ = the discount on $1 for 61 da.
∴ $1 – 0.010\frac{1}{6}$, or 0.989\frac{5}{6}$ = the proceeds of $1 of the note.
$100 = the entire proceeds.
∴ $100 : 0.989\frac{5}{6}$, or 101.03 = the number of dollars in the face.
∴ $101.03 = the face of the note.

14. 90 da. = the term of discount.
$0.015 = the discount on $1 for 90 da.
∴ $1 − $0.015, or $0.985 = the proceeds of $1 of the note.
$340 = the entire proceeds.
∴ $340 : $0.985, or 345.18 = the number of dollars in the face.
∴ $345.18 = the face of the note.

15. 3 mo. after Jan. 12, 1901, or April 12, 1901 = date of maturity.
Jan. 12, 1901 = the date of discount.
∴ 20 da. + 28 da. + 31 da. + 12 da., or 91 da. = the term of discount.
$0.015⅙ = the discount on $1 for 91 da.
∴ $1 − $0.015⅙, or $0.984⅚ = the proceeds of $1 of the note.
$60 = the entire proceeds.
∴ $60 : $0.984⅚, or 60.92 = the number of dollars in the face.
∴ $60.92 = the face of the note.

16. Aug. 12, 1901 = the date of maturity.
June 13, 1901 = the date of discount.
∴ 17 da. + 31 da. + 12 da., or 60 da. = the term of discount.
$0.01 = the discount on $1 for 60 da.
∴ $1 − $0.01, or $0.99 = the proceeds of $1 of the note.
$400 = the entire proceeds.
∴ $400 : $0.99, or 404.04 = the number of dollars in the face.
∴ $404.04 = the face of the note.

17. 90 da. after May 7, 1902, or Aug. 5, 1902 = the date of maturity.
July 7, 1902 = the date of discount.
∴ 25 da. + 5 da., or 30 da. = the term of discount.
$0.005 = the discount on $1 for 30 da.
∴ $1 − $0.005, or $0.995 = the proceeds of $1 of the note.
$595 = the entire proceeds.
∴ $595 : $0.995, or 597.99 = the number of dollars in the face.
∴ $597.99 = the face of the note.

18. 90 da. after May 1, 1901, or July 30, 1901 = date of maturity.
June 1, 1901 = date of discount.
∴ 30 da. + 30 da., or 60 da. = the term of discount.
∴ $0.01 = the discount on $1 for 60 da.
∴ $1 − $0.01, or $0.99 = the proceeds of $1 of the note.
$240 = the entire proceeds.
∴ $240 : $0.99, or 242.42 = number of dollars in the face.
∴ $242.42 = the face of the note.

19. Use Form 1, page 236, omitting *with interest at* 4%. Date the note at your home, making it payable at your home bank. Indorse in blank [p. 239]. The note should be discounted for 61 da. in Pennsylvania, Delaware, Maryland, and District of Columbia; for 64 da. in Missouri, and for 63 da. in all other states in which grace is allowed; for 60 da. in all states where grace is not allowed, except those mentioned in § 312, 2.

Exercise 117, Page 252.

1. 1¼% of $125, or $1.56 = the premium.
And $125 + $1.56, or $126.56 = the cost of the draft.

2. ⅛% of $500, or $0.625 = the discount.
And $500 − $0.625, or $499.38 = cost of the draft.

3. ½% of $250, or $1.25 = the premium.
And $250 + $1.25, or $251.25 = the cost of the draft.

4. ¼% of $500, or $1.25 = the discount.
And $500 − $1.25, or $498.75 = the cost of the draft.

5. $0.010⅛ = the bank discount on $1 for 60 da.
∴ $1 − $0.010⅛, or $0.989⅞ = the cost of $1 of the face, if exchange were at par.
$0.0075 = the exchange discount on $1 of the face.
∴ $0.989⅞ − $0.0075, or $0.982⅜ = the cost of $1 of the face.
And 140 × $0.982⅜, or $137.53 = the cost of the draft.

6. $0.015 = the bank discount on $1 for 90 da.
∴ $1 − $0.015, or $0.985 = proceeds of $1 of the face, if exchange were at par.
$0.00625 = the premium on $1 of the face.
∴ $0.985 + $0.00625, or $0.99125 = the cost of $1 of the face.
And 360 × $0.99125, or $356.85 = the proceeds of the draft.

7. 30 da. after Sept. 15, or Oct. 15 = the date of maturity.
Oct. 1 = the date of discount.
∴ 15 da. = the term of discount [§ 312, 2].
$0.0025 = the bank discount on $1 for 15 da. at 6%.
∴ $1 − $0.0025, or $0.9975 = cost of $1 of the face, if exchange were at par.
$0.00875 = the exchange discount on $1 of the face.
∴ $0.9975 − $0.00875, or $0.98875 = the cost of $1 of the face.
And 160 × $0.98875, or $158.20 = the cost of the draft.

8. $1\frac{1}{4}\%$ of $\$100$, or $\$1.25 =$ the premium.
$\therefore\ \$100 + \$1.25$, or $\$101.25 =$ the cost of the draft.

9. $60 \times \$3.25$, or $\$195 =$ the face of the draft.
1% of $\$195$, or $\$1.95 =$ the premium.
$\therefore\ \$195 + \$1.95$, or $\$196.95 =$ the sum received for the draft.

10. $\frac{1}{2}\%$ of $\$500$, or $\$2.50 =$ the discount.
$\therefore\ \$500 - \$2.50$, or $\$497.50 =$ the amount received.

11. 61 da. $=$ term of discount.
$\$0.010\frac{1}{6} =$ bank discount on $\$1$ for 61 da.
$\therefore\ \$1 - \$0.010\frac{1}{6}$, or $\$0.989\frac{5}{6} =$ the proceeds of $\$1$ of the face.
And $200 \times \$0.989\frac{5}{6}$, or $\$197.97 =$ proceeds of the draft.

12. 60 da. $-$ 10 da., or 50 da. $=$ the term of discount.
$\$0.008\frac{1}{3} =$ the bank discount on $\$1$ for 50 da.
$\therefore\ \$1 - \$0.008\frac{1}{3}$, or $\$0.991\frac{2}{3} =$ proceeds of $\$1$ of face, if exchange were at par.
Then, $500 \times \$0.991\frac{2}{3}$, or $\$495.83\frac{1}{3} =$ proceeds of draft, if exchange were at par.
$\frac{3}{8}\%$ of $\$500$, or $\$1.875 =$ the exchange discount on the draft.
$\therefore\ \$495.83\frac{1}{3} - \$1.875$, or $\$493.96 =$ the value of the draft.

13. $\$1 + \frac{1}{2}\%$ of $\$1$, or $\$1.005 =$ the value of $\$1$ of the face.
$\therefore\ \$600 : \$1.005$, or $597.01 =$ number of dollars in the face.
$\therefore\ \$597.01 =$ the face of the draft.

14. $\$0.01 =$ the bank discount of $\$1$ for 60 da. at 6%.
$\$0.00\frac{1}{6} =$ the bank discount of $\$1$ for 60 da. at 1%.
And $\$0.00\frac{5}{6} =$ the bank discount of $\$1$ for 60 da. at 5%.
$\therefore\ \$1 - \$0.00\frac{5}{6}$, or $\$0.99\frac{1}{6} =$ the cost of $\$1$ of the face, if exchange were at par.
$\$0.99\frac{1}{6} - \frac{1}{8}\%$ of $\$1$, or $\$0.99\frac{1}{24} =$ cost of $\$1$ of the face.
$\therefore\ \$250 : \$0.99\frac{1}{24}$, or $252.41 =$ the number of dollars in the face.
$\therefore\ \$252.41 =$ the face of the draft.

15. $\$1 + 1\frac{1}{4}\%$ of $\$1$, or $\$1.0125 =$ the value of $\$1$ of the face.
$\therefore\ \$600 : \$1.0125$, or $592.59 =$ the number of dollars in the face.
$\therefore\ \$592.59 =$ the face of the draft.

16. $\$1 + \frac{3}{4}\%$ of $\$1$, or $\$1.0075 =$ the value of $\$1$ of the face.
$\therefore\ \$600 : \$1.0075$, or $595.53 =$ number of dollars in the face.
$\therefore\ \$595.53 =$ the face of the draft.

Exercise 118, Page 255.

2. $\$4.85\frac{1}{4}$ = the value of £1.
∴ 240 × $\$4.85\frac{1}{4}$, or \$1164.60 = the value of the draft.

3. $\$4.84\frac{1}{4}$ = the value of £1.
∴ 25.3 × \$4.8425, or \$122.52 = the value of the draft.

4. $\$4.84\frac{3}{4}$ = the value of £1.
∴ $28\frac{21}{40}$ × $\$4.84\frac{3}{4}$, or \$138.27 = the value of the draft.

5. $5.14\frac{1}{2}$ francs = the value of \$1.
∴ 3250 francs : $5.14\frac{1}{2}$ francs, or 631.681 = the required number of dollars.
∴ \$631.68 = the value of the draft.

6. $5.16\frac{1}{4}$ francs = the value of \$1.
∴ 350 francs : $5.16\frac{1}{4}$ francs, or 67.796 = the required number of dollars.
∴ \$67.80 = the value of the draft.

7. 5.15 francs = the value of \$1.
∴ 5760 francs : 5.15 francs, or 1118.446 = the required number of dollars.
∴ \$1118.45 = the value of the draft.

8. $5.16\frac{3}{4}$ francs = the value of \$1.
∴ 500 francs : $5.16\frac{3}{4}$ francs, or 96.758 = the required number of dollars.
∴ \$96.76 = the value of the draft.

9. $\$0.95\frac{3}{8}$ = the value of 4 marks.
∴ $\frac{1}{4}$ of $\$0.95\frac{3}{8}$, or $\$0.23\frac{27}{32}$ = the value of 1 mark.
And 2340 × $\$0.23\frac{27}{32}$, or \$557.94 = the value of the draft.

10. $\$0.94\frac{1}{2}$ = the value of 4 marks.
∴ $\frac{1}{4}$ of $\$0.94\frac{1}{2}$, or $\$0.23\frac{5}{8}$ = the value of 1 mark.
And 4800 × $\$0.23\frac{5}{8}$, or \$1134 = the value of the draft.

11. \$0.95 = the value of 4 marks.
∴ $\frac{1}{4}$ of \$0.95, or $\$0.23\frac{3}{4}$ = the value of 1 mark.
And 4780 × $\$0.23\frac{3}{4}$, or \$1135.25 = the value of the draft.

12. $\$0.40\frac{3}{4}$ = the value of 1 guilder.
∴ 280 × $\$0.40\frac{3}{4}$, or \$114.10 = the value of the draft.

13. \$0.40 = the value of 1 guilder.
∴ 2740 × \$0.40, or \$1096 = the value of the draft.

14. $\$0.40\frac{3}{8}$ = the value of 1 guilder.
∴ $780 \times \$0.40\frac{3}{8}$, or $314.93 = the value of the draft.

15. $\$4.86\frac{1}{4}$ = the value of £1.
$942.50 = the entire value.
∴ $\$942.50 : \$4.86\frac{1}{4}$, or 193.83 = the number of pounds in the draft.
∴ £193 16*s.* 7*d.* = the face of the draft.

16. $\$4.87\frac{1}{2}$ = the value of £1.
$731.25 = the entire value of the draft.
∴ $731.25 : $4.875, or 150 = the number of pounds in the draft.
∴ £150 = the face of the draft.

17. $5.14\frac{3}{8}$ francs = the value of $1.
∴ $400 \times 5.14\frac{3}{8}$ francs, or 2057.5 francs = the face of the draft.

18. $5.13\frac{7}{8}$ francs = the value of $1.
∴ $250 \times 5.13\frac{7}{8}$ francs, or 1284.69 francs = the face of the draft.

19. $\$0.95\frac{3}{8}$ = the value of 4 marks.
∴ $\frac{1}{4}$ of $\$0.95\frac{3}{8}$, or $\$0.23\frac{27}{32}$ = the value of 1 mark.
$76.30 = the entire value of the draft.
∴ $\$76.30 : \$0.23\frac{27}{32}$, or 320 = the required number of marks.
∴ 320 marks = the face of the draft.

20. $\$0.94\frac{1}{2}$ = the value of 4 marks.
∴ $\frac{1}{4}$ of $\$0.94\frac{1}{2}$, or $\$0.23\frac{5}{8}$ = the value of 1 mark.
$113.40 = the entire value of the draft.
∴ $\$113.40 : \$0.23\frac{5}{8}$, or 480 = the required number of marks.
∴ 480 marks = the face of the draft.

21. $\$0.40\frac{1}{4}$ = the value of 1 guilder.
$112.70 = the entire value of the draft.
∴ $\$112.70 : \$0.40\frac{1}{4}$, or 280 = the required number of guilders.
∴ 280 guilders = the face of the draft.

22. $\$0.40\frac{3}{4}$ = the value of 1 guilder.
$203.75 = the entire value of the draft.
∴ $\$203.75 : \$0.40\frac{3}{4}$, or 500 = the required number of guilders.
∴ 500 guilders = the face of the draft.

23. $5.14\frac{1}{2}$ francs = the value of $1.
∴ 5460 francs : $5.14\frac{1}{2}$ francs, or 1061.224 = the required number of dollars.
∴ $1061.22 = the value of the draft.

24. $\$0.95\frac{3}{8}$ = the value of 4 marks.
∴ $\frac{1}{4}$ of $\$0.95\frac{3}{8}$, or $\$0.23\frac{27}{32}$ = the value of 1 mark.
Then, $\$1000 : \$0.23\frac{27}{32}$, or 4193.971 = the required number of marks
∴ 4193.97 marks = the face of the draft.

Exercise 119, Page 259.

1. Principal, Sept. 1, 1899,		$300.00
Interest on the principal for 1 yr.,		18.00
Amount, Sept. 1, 1900,		$318.00
First payment, June 1, 1900,	$50.00	
Interest on first payment to Sept. 1, 1900 (92 da.),	.77	50.77
New principal, Sept. 1, 1900,		$267.23
Interest on the principal to June 1, 1901 (273 da.),		12.16
Amount, June 1, 1901,		$279.39
Second payment, Sept. 1, 1900,	$50.00	
Interest on second payment to June 1, 1901 (273 da.),	2.275	
Third payment, Jan. 2, 1901,	100.00	
Interest on third payment to June 1, 1901 (150 da.),	2.50	154.78
Balance due, June 1, 1901,		$124.61

2. Principal, June 1, 1900,		$500.00
Interest on the principal for 1 yr.,		22.50
Amount, June 1, 1901,		$522.50
First payment, April 1, 1901,	$50.00	
Interest on first payment to June 1, 1901 (61 da.),	.38	50.38
New principal, June 1, 1901,		$472.12
Interest on the principal for 1 yr.,		21.24
Amount, June 1, 1902,		$493.36
Second payment, Aug. 1, 1901,	$100.00	
Interest on second payment to June 1, 1902 (304 da.),	3.80	103.80
New principal, June 1, 1902,		$389.56
Interest on principal to July 1, 1902 (30 da.),		1.46
Amount, July 1, 1902,		$391.02
Third payment, Dec. 1, 1901,	$150.00	
Interest on third payment to July 1, 1902 (212 da.),	3.98	153.98
Balance due, July 1, 1902,		$237.04

3. Principal, July 1, 1900,		$500.00
Interest on principal for 1 yr.,		30.00
Amount, July 1, 1901,		$530.00

Amount, July 1, 1901,		$ 530.00
First payment, May 1, 1901,	$ 50.00	
Interest on first payment to July 1, 1901 (61 da.),	.51	
Second payment, July 1, 1901,	100.00	150.51
New principal, July 1, 1901,		$ 379.49
Interest on new principal for 1 yr.,		22.77
Amount, July 1, 1902,		$ 402.26
Third payment, Jan. 2, 1902,	$ 50.00	
Interest on third payment to July 1, 1902 (180 da.),	1.50	
Fourth payment, July 1, 1902,	5.00	56.50
New principal, July 1, 1902,		$ 345.76
Interest on new principal to Dec. 31, 1902 (183 da.),		10.55
Amount due, Dec. 31, 1902,		$ 356.31

4. Principal, May 1, 1899,		$ 1000.00
Interest on principal for 1 yr.,		45.00
Amount, May 1, 1900,		$ 1045.00
First payment, March 20, 1900,	$ 200.00	
Interest on first payment to May 1, 1900 (42 da.),	1.05	201.05
New principal, May 1, 1900,		$ 843.95
Interest on new principal for 1 yr. (May 1, 1901),		37.98
Amount, May 1, 1901,		$ 881.93
Second payment, June 15, 1900,	$ 100.00	
Interest on second payment to May 1, 1901 (320 da.),	4.00	104.00
New principal, May 1, 1901,		$ 777.93
Interest on new principal to March 1, 1902 (304 da.),		29.56
Amount, March 1, 1902,		$ 807.49
Third payment, Sept. 1, 1901,	$ 50.00	
Interest on third payment to March 1, 1902 (181 da.),	1.13	
Fourth payment, Dec. 31, 1901,	200.00	
Interest on fourth payment to March 1, 1902 (60 da.),	1.50	252.63
Amount due, March 1, 1902,		$ 554.86

5. Payments were made on the following dates: Sept. 1, 1899, $ 100; March 1, 1900, $ 100; Sept. 1, 1900, $ 100; March 1, 1901, $ 100; Sept. 1, 1901, $ 100.

Principal, March 1, 1899,	$ 600.00
Interest on the principal for 1 yr.,	36.00
Amount, March 1, 1900,	$ 636.00

Amount, March 1, 1900,		$636.00
First payment, Sept. 1, 1899,	$100.00	
Interest on first payment to March 1, 1900 (6 mo.),	3.00	103.00
New principal, March 1, 1900,		$533.00
Interest on new principal for 1 yr. (March 1, 1901),		31.98
Amount, March 1, 1901,		$564.98
Second payment, March 1, 1900,	$100.00	
Interest on second payment to March 1, 1901 (1 yr.),	6.00	
Third payment, Sept. 1, 1900,	100.00	
Interest on third payment to March 1, 1901 (6 mo.),	3.00	209.00
New principal, March 1, 1901,		$355.98
Interest on new principal for 1 yr. (March 1, 1902),		21.36
Amount, March 1, 1902,		$377.34
Fourth payment, March 1, 1901,	$100.00	
Interest on fourth payment to March 1, 1902 (1 yr.),	6.00	
Fifth payment, Sept. 1, 1901,	100.00	
Interest on fifth payment to March 1, 1902 (6 mo.),	3.00	209.00
Balance due, March 1, 1902,		$168.34

6. Principal, Feb. 1, 1901,	$400.00
Interest on the principal from Feb. 1, 1901, to July 15, 1901 (164 da.),	7.29
Amount, July 15, 1901,	$407.29
First payment,	200.00
New principal, July 15, 1901,	$207.29
Interest on the principal from July 15, 1901, to Feb. 1, 1902 (201 da.),	4.63
Amount, Feb. 1, 1902,	$211.92
Second payment,	100.00
New principal, Feb. 1, 1902,	$111.92
Interest on new principal from Feb. 1, 1902, to Sept. 15, 1902 (226 da.),	2.81
Amount, Sept. 15, 1902,	$114.73
Third payment,	50.00
New principal, Sept. 15, 1902,	$64.73
Interest on new principal from Sept. 15, 1902, to Feb. 1, 1903 (139 da.),	1.00
Amount due Feb. 1, 1903,	$65.73

7. Principal, July 1, 1901,	$600.00
Interest on principal from July 1, 1901, to Oct. 20, 1901 (111 da.),	8.33
Amount, Oct. 20, 1901,	$608.33
First payment,	200.00
New principal, Oct. 20, 1901,	$408.33
Interest on new principal from Oct. 20, 1901, to May 1, 1902 (193 da.),	9.85
Amount, May 1, 1902,	$418.18
Second payment,	10.00
New principal, May 1, 1902,	$408.18
Interest on new principal from May 1, 1902, to Nov. 15, 1902 (198 da.),	10.10
Amount, Nov. 15, 1902,	$418.28
Third payment,	200.00
New principal, Nov. 15, 1902,	$218.28
Interest on new principal from Nov. 15, 1902, to Dec. 19, 1902 (34 da.),	.93
Amount due, Dec. 19, 1902,	$219.21
Fourth payment,	100.00
New principal, Dec. 19, 1902,	$119.21
Interest on new principal from Dec. 19, 1902, to Feb. 1, 1903 (44 da.),	.66
Amount due, Feb. 1, 1903,	$119.87

8. Principal, June 1, 1900,	$500.00
Interest on principal from June 1, 1900, to April 1, 1901 (304 da.),	19.00
Amount, April 1, 1901,	$519.00
First payment,	50.00
New principal, April 1, 1901,	$469.00
Interest on principal from April 1, 1901, to Aug. 1, 1901 (122 da.),	7.15
Amount, Aug. 1, 1901,	$476.15
Second payment,	100.00
New principal, Aug. 1, 1901,	$376.15
Interest on principal from Aug. 1, 1901, to Dec. 1, 1901 (122 da.),	5.74
Amount, Dec. 1, 1901,	$381.89

Amount, Dec. 1, 1901,	$381.89
Third payment,	150.00
New principal, Dec. 1, 1901,	$231.89
Interest on principal from Dec. 1, 1901, to July 1, 1902 (212 da.),	6.15
Amount due, July 1, 1902,	$238.04

9. Principal, July 1, 1900,	$500.00
Interest on principal from July 1, 1900, to May 1, 1901 (304 da.),	25.3333
Amount, May 1, 1901,	$525.3333
First payment,	50.00
New principal, May 1, 1901,	$475.3333
Interest on new principal from May 1, 1901, to July 1, 1901 (61 da.),	4.8325
Amount, July 1, 1901,	$480.1658
Second payment,	100.00
New principal, July 1, 1901,	$380.1658
Interest on new principal from July 1, 1901, to Jan. 2, 1902 (185 da.),	11.7167
Amount, Jan. 2, 1902,	$391.8825
Third payment,	50.00
New principal, Jan. 2, 1902,	$341.8825
Interest on new principal from July 2, 1902, to July 1, 1902 (180 da.), $10.2564.	
(The interest due July 1, 1902, exceeds payment then made and no settlement is made.)	
Interest on the principal from Jan. 2, 1902, to Dec. 31, 1902 (363 da.),	20.6838
Amount, Dec. 31, 1902,	$362.5663
Payment made July 1, 1902,	5.00
Amount due, Dec. 31, 1902,	$357.5663
	= $357.57

Exercise 120, Page 262.

11. Let x = the consequent.
Then, $12\frac{1}{2} = 8 : x$. Therefore, $\frac{25}{2}x = 8$.
Whence, $x = \frac{2}{25} \times 8 = \frac{16}{25}$.

12. Let $x =$ the number of bushels in the antecedent.

Then, $\frac{5}{6} = x : 3\frac{3}{4}$. Therefore, $\frac{x}{3\frac{3}{4}} = \frac{5}{6}$.

Whence, $\frac{4x}{15} = \frac{5}{6}$; or $4x = \frac{75}{6}$; and $x = 3\frac{1}{8}$.

∴ the antecedent $= 3\frac{1}{8}$ bu.

13. $3 \times$ A's $= 4 \times$ B's.

∴ A's $= \frac{4}{3} \times$ B's; whence, A's : B's $= \frac{4}{3}$, or $1\frac{1}{3}$.

14. $\frac{2}{3}$ of John's $= \frac{4}{5}$ of William's.

∴ John's $= \frac{3}{2}$ of $\frac{4}{5}$ of William's, or $\frac{6}{5}$ of William's.

Whence, John's : William's $= \frac{6}{5}$, or $1\frac{1}{5}$.

15. The ratio of the first to the second $= \frac{75}{50}$, or $1\frac{1}{2}$.

∴ the first $= \frac{3}{2}$ of the second.

Or, $12 = \frac{3}{2}$ of the second.

∴ the second $= \frac{2}{3}$ of $12 = 8$.

16. The ratio of the first to the second $= \frac{2}{3} : \frac{3}{4} = 8 : 9 = \frac{8}{9}$.

∴ the first $= \frac{8}{9}$ of the second $= \frac{8}{9}$ of $\frac{8}{9} = \frac{64}{81}$.

17. The ratio of the weight of olive oil to that of water $= 57.19$ lb. : 62.5 lb. $= 57.19 : 62.5 = 571.9 : 625 = \frac{1}{625}$ of $571.90 = .915+$, or $.92$.

18. The ratio of the weight of silver to that of water $= 10.47$.

∴ the weight of a cubic foot of silver $= 10.47 \times$ the weight of a cubic foot of water $= 10.47 \times 62.5$ lb. $= 654.375$ lb. $= 654\frac{3}{8}$ lb.

19. 1 lb. Troy $= 5760$ gr. 1 lb. Avoirdupois $= 7000$ gr.

∴ 1 lb. Troy : 1 lb. Avoirdupois $= 5760 : 7000 = \frac{5760}{7000}$, or $\frac{144}{175}$.

20. 1 oz. Troy $= 480$ gr. 1 oz. Avoirdupois $= 437\frac{1}{2}$ gr.

∴ 1 oz. Troy : 1 oz. Avoir. $= 480 : 437\frac{1}{2} = 960 : 875 = \frac{960}{875} = 1\frac{17}{175}$.

21. 1 cu. ft. : 1 stricken bushel $= \frac{4}{5}$.

∴ 1 cu. ft. $= \frac{4}{5}$ of a stricken bushel.

Whence, 1 stricken bushel $= \frac{5}{4}$ of a cubic foot.

And 240 stricken bushels $= 240 \times \frac{5}{4}$ of a cubic foot $= 300$ cu. ft.

∴ $300 =$ the number of cubic feet in the bin.

Exercise 122, Page 266.

3. (*a*) Directly proportional.
(*b*) Directly proportional.
(*c*) Inversely proportional.
(*d*) Directly proportional.
(*e*) Inversely proportional.
(*f*) Inversely proportional.
(*g*) Directly proportional.
(*h*) Directly proportional.

4. Let $x =$ the number of dollars required.
Then, $\$x$ is charged for the loan of $\$750$,
if $\$4.50$ is charged for the loan of $\$100$.
The sum charged is directly proportional to the sum loaned.

$$\therefore\ x : 4.50 = 750 : 100.$$

Whence, $$x = \frac{4.50 \times 750}{100}, \text{ or } 33.75.$$

$$\therefore\ \$33.75 = \text{the required sum.}$$

5. Let $x =$ the number of dollars required.
Then, $\$x$ is charged for 100 lb.,
if $\$4.50$ is charged for 196 lb.
The sum charged is directly proportional to the sum bought.

$$\therefore\ x : 4.50 = 100 : 196.$$

Whence, $$x = \frac{100 \times 4.50}{196}, \text{ or } 2.30.$$

$$\therefore\ \$2.30 = \text{the required cost.}$$

6. Let $x =$ the number of dollars required.
Then, $\$x$ is charged for 1440 lb.,
if $\$0.28$ is charged for 100 lb.
The cost is directly proportional to the weight bought.

$$\therefore\ x : .28 = 1440 : 100.$$

$$x = \frac{.28 \times 1440}{100}, \text{ or } 4.03.$$

$$\therefore\ \$4.03 = \text{the required cost.}$$

7. Let $x =$ the number of dollars required.
Then, $\$x$ is charged for 1250 lb.,
if $\$18$ is charged for 2000 lb.
The cost is directly proportional to the weight bought.

$$\therefore\ x : 18 = 1250 : 2000.$$

Whence, $$x = \frac{18 \times 1250}{2000}, \text{ or } 11.25.$$

$$\therefore\ \$11.25 = \text{the required cost.}$$

8. Let $x =$ the number of feet required.
Then, x ft. is the length of the tree whose shadow is 72 ft.,
if 10 ft. is the length of the pole whose shadow is 25 ft.
The height of the object is directly proportional to the length of the shadow.

$$\therefore\ x : 10 = 72 : 25.$$

Whence, $x = \frac{10 \times 72}{25}$, or $28\frac{4}{5}$.

$\therefore$ $28\frac{4}{5}$ ft. = the height of the tree.

9. Let x = the number of cubic feet required.
Then, x cu. ft. = 60 bu.,
if 5 cu. ft. = 4 bu.

The number of cubic feet in a bin is directly proportional to the number of bushels it will hold.

$$\therefore\ x : 5 = 60 : 4.$$

Whence, $x = \frac{5 \times 60}{4}$, or 75.

10. Let x = the number of inches required.
Then, x in. is the length of an arc of 20°,
if 15 in. is the length of an arc of 90°.

The length of the arc in inches is directly proportional to its length in degrees.

$$\therefore\ x : 15 = 20 : 90.$$

Whence, $x = \frac{15 \times 20}{90}$, or $3\frac{1}{3}$.

$\therefore$ $3\frac{1}{3}$ in. = the length of the arc of 20°.

Note. The solutions of the remaining problems of this exercise will be somewhat shortened, the work shown being as much as is necessary in practice.

11.

Total Cost.	Cost per Pound.
x ct.	8 ct.
25 ct.	$6\frac{1}{4}$ ct.

The total cost is directly proportional to the cost per pound.

$$\therefore\ x : 25 = 8 : 6\tfrac{1}{4}.$$

Whence, $x = \frac{8 \times 25}{6\frac{1}{4}}$, or 32.

12.

Speed.	Time.
x mi.	$3\frac{1}{4}$ hr.
30 mi.	$5\frac{1}{2}$ hr.

The speed is inversely proportional to the time.

$$\therefore\ x : 30 = 5\tfrac{1}{2} : 3\tfrac{1}{4}.$$

Whence, $x = \frac{30 \times 5\frac{1}{2}}{3\frac{1}{4}}$, or $50\frac{10}{13}$.

13.

Quantity of Lime.	Number of Bricks.
x bbl.	16225
$1\frac{1}{8}$ bbl.	1000

The quantity of lime required is directly proportional to the number of bricks used.

$$\therefore\ x : 1\tfrac{1}{8} = 16225 : 1000.$$

Whence, $$x = \frac{1\frac{1}{8} \times 16225}{1000}, \text{ or } 18.253125.$$

14.

Weight.	Size of Pound.
x lb.	$15\frac{3}{4}$ oz.
40 lb.	16 oz.

The number of pounds is inversely proportional to the size of the pound.

$$\therefore\ x : 40 = 16 : 15\tfrac{3}{4}.$$

Whence, $$x = \frac{40 \times 16}{15\frac{3}{4}}, \text{ or } 40\tfrac{40}{63}.$$

15.

Cost.	Quantity.
x ct.	3 packages
100 ct.	12 packages

The cost is directly proportional to the quantity bought.

$$\therefore\ x : 100 = 3 : 12.$$

Whence, $$x = 25.$$

16.

Cost.	Quantity.
$\$x$	$2\frac{1}{2}$ bu.
\$75	100 bu.

The cost is directly proportional to the quantity bought.

$$\therefore\ x : 75 = 2\tfrac{1}{2} : 100.$$

Whence, $$x = \frac{75 \times 2\frac{1}{2}}{100}, \text{ or } 1\tfrac{7}{8}.$$

17.

Statute Miles.	Geographic Miles.
x	21600
69.16	60

The number of statute miles in any length is directly proportional to the number of geographic miles in it.

$$\therefore\ x : 69.16 = 21600 : 60.$$

Whence, $$x = \frac{69.16 \times 21600}{60}, \text{ or } 24897.60.$$

18.

Time.	Time per Night.
x nights	3 hr.
200 nights	4 hr.

The number of nights the lamp will last is inversely proportional to the number of hours it burns per night.

$$\therefore\ x : 200 = 4 : 3.$$

Whence, $$x = \frac{4 \times 200}{3},\text{ or } 266\tfrac{2}{3}.$$

19.

Length on Plot.	Length Represented.
x in.	100 rd.
6.25 in.	112.5.

The length on the plot is directly proportional to the length of the line represented.

$$\therefore\ x : 6.25 = 100 : 112.5.$$

Whence, $$x = \frac{6.25 \times 100}{112.5},\text{ or } 5\tfrac{5}{9}.$$

The lengths on the plot that will represent the remaining sides may be found in the same manner as the above.

20.

Weight of Milk.	Weight of Water.
x lb.	1000 lb.
$64\frac{3}{8}$ lb.	$62\frac{1}{2}$ lb.

The weight of milk that any vessel holds is directly proportional to the weight of water it holds.

$$\therefore\ x : 64\tfrac{3}{8} = 1000 : 62\tfrac{1}{2}.$$

Whence, $$x = \frac{64\frac{3}{8} \times 1000}{62\frac{1}{2}},\text{ or } 1030.$$

21. (1)

Quantity.	Length.
x bd. ft.	10 ft.
576 bd. ft.	24 ft.

The amount of lumber in a log is directly proportional to its length.

$$\therefore\ x : 576 = 10 : 24.$$

Whence, $$x = \frac{576 \times 10}{24},\text{ or } 240.$$

(2) The length of the second piece is 14 ft., and the statement is:

x bd. ft.	14 ft.
576 bd. ft.	24 ft.

The proportion is: $$x : 576 = 14 : 24.$$

22. Shelled corn weighs 56 lb. per bushel and wheat 60 lb.

Entire Weight.	Weight per Bushel.
x lb.	56 lb.
2400 lb.	60 lb.

The entire weight is directly proportional to the weight per bushel.

$$\therefore\ x : 2400 = 56 : 60.$$

Whence, $$x = \frac{2400 \times 56}{60},\ \text{or } 2240.$$

23.

Weight.	Size of Pound.
x lb. (Avoir.)	7000 gr.
240 lb. (Troy)	5760 gr.

The number of pounds in the weight of a mass is inversely proportional to the size of the pound used in weighing.

$$\therefore\ x : 240 = 5760 : 7000.$$

Whence, $$x = \frac{240 \times 5760}{7000},\ 197\tfrac{17}{35}.$$

24

Distance Freight Train Runs.	Distance Passenger Train Runs.
x mi.	99 mi.
$10\frac{5}{6}$ mi.	$24\frac{3}{4}$ mi.

The distance the freight train runs is directly proportional to the distance the passenger train runs.

$$\therefore\ x : 10\tfrac{5}{6} = 99 : 24\tfrac{3}{4}.$$

Whence, $$x = \frac{10\frac{5}{6} \times 99}{24\frac{3}{4}},\ \text{or } 43\tfrac{1}{3}.$$

25.

Number of Bricks.	Area Paved.
x	180 sq. yd.
81	2 sq. yd.

The number of bricks required is directly proportional to the number of square yards to be paved.

$$\therefore\ x : 81 = 180 : 2.$$

Whence, $$x = \frac{81 \times 180}{2},\ \text{or } 7290.$$

26.

Number of Shingles.	Size of Roof.
x	540 sq. ft.
600	100 sq. ft.

The number of shingles required is directly proportional to the size of the roof to be covered.

$$\therefore\ x : 600 = 540 : 100.$$

Whence, $$x = \frac{600 \times 540}{100}, \text{ or } 3240.$$

27.

Number of Bushels.	Weight per Bushel.
x	32 lb.
240	30 lb.

The number of bushels is inversely proportional to the weight taken for a bushel.

$$\therefore\ x : 240 = 30 : 32.$$

Whence, $$x = \frac{30 \times 240}{32}, \text{ or } 225.$$

28.

Amount to the Acre.	Area Covered.
x lb.	10 A.
240 lb.	8 A.

The amount sowed to the acre is inversely proportional to the area covered.

$$\therefore\ x : 240 = 8 : 10.$$

Whence, $$x = \frac{240 \times 8}{10}, \text{ or } 192.$$

Exercise 123, Page 269.

2.

Quantity.	Amount of Stock.	Time.
x bu.	16 horses	3 da.
21 bu.	8 horses	7 da.

The quantity is directly proportional to both the amount of stock and the time.

$$\therefore\ x : 21 = \begin{cases} 16 : 8 \\ 3 : 7. \end{cases}$$

Whence, $$x = \frac{21 \times 16 \times 3}{8 \times 7}, \text{ or } 18.$$

3.

Quantity.	Length.	Height.
x ft.	24 yd.	$4\frac{1}{2}$ ft.
300 ft.	30 yd.	5 ft.

The quantity of boards required is directly proportional to both the length and the height of the fence.

$$\therefore\ x : 300 = \begin{cases} 24 : 30 \\ 4\frac{1}{2} : 5. \end{cases}$$

Whence, $$x = \frac{300 \times 24 \times 4\frac{1}{2}}{30 \times 5}, \text{ or } 216.$$

4.

Width.	Length.	Area.
x yd.	220 yd.	$3\frac{1}{2}$ A.
80 yd.	121 yd.	2 A.

The width required is inversely proportional to the length of the lot and directly proportional to the area.

$$\therefore\ x : 80 = \begin{cases} 121 : 220 \\ 3\frac{1}{2} : 2. \end{cases}$$

Whence, $$x = \frac{80 \times 121 \times 3\frac{1}{2}}{220 \times 2}, \text{ or } 77.$$

5.

Interest.	Principal.	Time.
$\$x$	\$250	$2\frac{1}{2}$ yr.
\$9	\$100	2 yr.

The interest charged is directly proportional to the sum loaned, and also to the time for which it is loaned.

$$\therefore\ x : 9 = \begin{cases} 250 : 100 \\ 2\frac{1}{2} : 2. \end{cases}$$

Whence, $$x = \frac{9 \times 250 \times 2\frac{1}{2}}{100 \times 2}, \text{ or } 28.13.$$

6.

Time.	Length.	Width.	Height.
x da.	48 ft.	3 ft.	$3\frac{3}{4}$ ft.
10 da.	180 ft.	$2\frac{1}{2}$ ft.	4 ft.

The time required is directly proportional to the length of the wall, to its width, and to its height.

$$\therefore\ x : 10 = \begin{cases} 48 : 180 \\ 3 : 2\frac{1}{2} \\ 3\frac{3}{4} : 4. \end{cases}$$

Whence, $$x = \frac{10 \times 48 \times 3 \times 3\frac{3}{4}}{180 \times 2\frac{1}{2} \times 4}, \text{ or } 3.$$

7. If a certain number of men can build a wall 60 yd. long, $2\frac{1}{2}$ ft. wide, and 4 ft. high, in 10 da., to what height could they build a wall 48 ft. long and 3 ft. wide in 12 da.?

Height.	Length.	Width.	Time.
x ft.	48 ft.	3 ft.	12 da.
4 ft.	180 ft.	$2\frac{1}{2}$ ft.	10 da.

The height is inversely proportional to the length, and also to the width, and directly proportional to the time.

$$\therefore\ x : 4 = \begin{cases} 180 : 48 \\ 2\tfrac{1}{2} : 3 \\ 12 : 10. \end{cases}$$

Whence, $$x = \frac{4 \times 180 \times 2\tfrac{1}{2} \times 12}{48 \times 3 \times 10}, \text{ or } 15.$$

8.

Number of Revolutions.	Circumference.	Distance.
x	4 ft.	3520 ft.
880	6 ft.	5280 ft.

The number of revolutions is inversely proportional to the circumference of the wheel and directly proportional to the distance.

$$\therefore\ x : 880 = \begin{cases} 6 : 4, \\ 3520 : 5280. \end{cases}$$

Whence, $$x = \frac{880 \times 6 \times 3520}{4 \times 5280}, \text{ or } 880.$$

9. If a wheel 6 ft. in circumference makes 880 revolutions in going a mile, what must be the circumference of a wheel that would make 660 revolutions in going 3520 ft.?

Circumference.	Number of Revolutions.	Distance.
x ft.	660	3520 ft.
6 ft.	880	5280 ft.

The circumference is inversely proportional to the number of revolutions and directly proportional to the distance.

$$\therefore\ x : 6 = \begin{cases} 880 : 660 \\ 3520 : 5280. \end{cases}$$

Whence, $$x = \frac{6 \times 880 \times 3520}{660 \times 5280}, \text{ or } 5\tfrac{1}{3}.$$

10.

Quantity.	Time.	Number of Lamps.	Time per Night.
x gal.	365 nights.	24	7 hr.
1¼ gal.	6 nights.	2	4 hr.

The quantity of oil required is directly proportional to the time the lights are to be used, to the number of lamps used, and to the length of time they are used per night.

$$\therefore\ x : 1\tfrac{1}{4} = \left\{\begin{array}{r} 365 : 6 \\ 24 : 2 \\ 7 : 4. \end{array}\right.$$

Whence, $$x = \frac{1\frac{1}{4} \times 365 \times 24 \times 7}{6 \times 2 \times 4},\ \text{or } 1596\tfrac{7}{8}.$$

11.

Time.	Length of Day.	Force.	Length.	Height.	Thickness.
x da.	8 hr.	3 men	30 ft.	8 ft.	3 bricks
2 da.	10 hr.	1 man	24 ft.	10 ft.	2 bricks

The time required is inversely proportional to the length of day the force works and to the force, and directly proportional to the length, to the height, and to the thickness of the wall.

$$\therefore\ x : 2 = \left\{\begin{array}{r} 10 : 8 \\ 1 : 3 \\ 30 : 24 \\ 8 : 10 \\ 3 : 2. \end{array}\right.$$

Whence, $$x = \frac{2 \times 10 \times 1 \times 30 \times 8 \times 3}{8 \times 3 \times 24 \times 10 \times 2},\ \text{or } 1\tfrac{1}{4}.$$

12.

Time.	Length.	Width.	Height.	Amount of Stock.
x wk.	28 ft.	20 ft.	12 ft.	5 horses
20 wk.	32 ft.	16 ft.	16 ft.	8 horses

The time is directly proportional to the length, to the width, and to the height of the mow, and inversely proportional to the amount of stock.

$$\therefore\ x : 20 = \left\{\begin{array}{r} 28 : 32 \\ 20 : 16 \\ 12 : 16 \\ 8 : 5. \end{array}\right.$$

Whence, $$x = \frac{20 \times 28 \times 20 \times 12 \times 8}{32 \times 16 \times 16 \times 5},\ \text{or } 26\tfrac{1}{4}.$$

13.

Time.	Length of Day.	Force.	Length.	Width.
x da.	10 hr.	8 men	66 ft.	40 ft.
20 da.	8 hr.	10 men	5280 ft.	60 ft.

The time required is inversely proportional to the length of day the force works and to the force, and directly proportional to the length and the width of the wall.

$$\therefore\ x : 20 = \begin{cases} 8 : 10 \\ 10 : 8 \\ 66 : 5280 \\ 40 : 60. \end{cases}$$

Whence, $x = \dfrac{20 \times 8 \times 10 \times 66 \times 40}{10 \times 8 \times 5280 \times 60}$, or $\frac{1}{6}$.

Exercise 124, Page 271.

6. The smaller $= \frac{3}{5}$ of the larger.
Whence, their sum $= \frac{8}{5}$ of the larger $= 24$.
$\therefore$ the larger $= \frac{5}{8}$ of $24 = 15$, and the smaller $= 24 - 15 = 9$.

7. The weight of a bushel of wheat $= \frac{15}{8}$ of the weight of a bushel of oats.
Whence, $\frac{23}{8}$ of the weight of a bushel of oats $=$ the weight of 1 bu. of both $= 92$ lb.
$\therefore$ $\frac{8}{23}$ of 92 lb. $= 32$ lb. $=$ the weight of a bushel of oats.
And $\frac{15}{8}$ of 32 lb. $= 60$ lb. $=$ the weight of a bushel of wheat.

8. The smaller $= \frac{2}{3}$ of the larger.
Whence, $\frac{1}{3}$ of the larger $=$ their difference $= 15$.
And the larger $= 3 \times 15 = 45$, and the smaller $= \frac{2}{3}$ of $45 = 30$.

9. A's investment $= \frac{6}{5}$ of B's.
Whence, $\frac{6}{5}$ of B's $- \frac{5}{5}$ of B's $= \frac{1}{5}$ of B's $=$ the difference $= \$75$.
$\therefore$ B's $= 5 \times \$75 = \$375$, and A's $= \frac{6}{5}$ of $\$375 = \$450$.

10. B's investment $= \frac{2}{3}$ of A's.
Whence, $\frac{3}{3}$ A's $+ \frac{2}{3}$ A's $= \frac{5}{3}$ A's $=$ their sum $= \$275$.
$\therefore$ A's $= \frac{3}{5}$ of $\$275 = \$165$, and B's $= \frac{2}{3}$ of $\$165 = \$110$.

12. $\frac{2}{3} : \frac{3}{5} = 10 : 9$. $\therefore$ the smaller part $= \frac{9}{10}$ of the greater.
Whence, $\frac{19}{10}$ of the greater $=$ their sum $= \frac{2}{3}$.

$\therefore$ $\frac{10}{19}$ of $\frac{2}{3} = \frac{20}{57} =$ the greater, and $\dfrac{\overset{3}{\cancel{9}}}{\cancel{10}}$ of $\dfrac{\overset{2}{\cancel{20}}}{\underset{19}{\cancel{57}}} = \dfrac{6}{19} =$ the smaller.

13. $.5 : .33\frac{1}{3} = \frac{1}{2} : \frac{1}{3} = 3 : 2$. $\therefore$ $\frac{2}{3}$ of the larger = the smaller.
Whence, $\frac{5}{3}$ of the larger = their sum $= 2.75$.
$\therefore$ $\frac{3}{5}$ of $2.75 = 1.65$ = the larger, and $\frac{2}{3}$ of $1.65 = 1.1$ = the smaller.

14. The smaller = $\frac{6}{7}$ of the larger; whence, $\frac{1}{7}$ of the larger $= \frac{1}{12}$.
$\therefore$ $7 \times \frac{1}{12} = \frac{7}{12}$ = the larger, and $\frac{6}{7}$ of $\frac{7}{12} = \frac{1}{2}$ = the smaller.

15. $\frac{1}{2}$ lb. : $\frac{3}{4}$ lb. $= 2 : 3$. $\therefore$ the amount of black tea $= \frac{2}{3}$ of the amount of green.
Whence, $\frac{5}{3}$ of the amount of green tea = the amount of both = 10 lb.
$\therefore$ $\frac{3}{5}$ of 10 lb. = 6 lb. = the amount of green tea.
And $\frac{2}{3}$ of 6 lb. = 4 lb. = the amount of black tea.

16. $1 : 1\frac{1}{2} = 2 : 3$. $\therefore$ the amount of tin $= \frac{2}{3}$ of the amount of lead.
Whence, $\frac{5}{3}$ of the amount of lead = the whole amount = 2 lb.
$\therefore$ $\frac{3}{5}$ of 2 lb. $= 1\frac{1}{5}$ lb. = the amount of lead.
And $\frac{2}{3}$ of $\frac{6}{5}$ lb. $= \frac{4}{5}$ lb. = the amount of tin.

17. $1 : 4\frac{1}{2} = 2 : 9$. $\therefore$ the amount of antimony $= \frac{2}{9}$ of the amount of lead.
Whence, $\frac{11}{9}$ of the amount of lead = the whole amount = 100 lb.
$\therefore$ $\frac{9}{11}$ of 100 lb. $= \frac{900}{11}$ lb. $= 81\frac{9}{11}$ lb. = the amount of lead.
And $\frac{2}{9}$ of $\frac{900}{11}$ lb. $= \frac{200}{11}$ lb. $= 18\frac{2}{11}$ lb. = the amount of antimony.

19. The time the first worked $= \frac{2}{3}$ of the time the second worked.
$\therefore$ the amount the first should receive $= \frac{2}{3}$ of the second's amount.
Whence, $\frac{5}{3}$ of the second's amount = the entire sum $= \$36$.
$\therefore$ $\frac{3}{5}$ of $\$36 = \$21.60$ = the second's amount.
And $\frac{2}{3}$ of $\$21.60 = \$14.40$ = the first's amount.

21. Divide 100 bu. into $2+3+5$, or 10 equal parts, each part = 10 bu.
$\therefore$ 2 parts = 20 bu. = the amount of oats.
3 parts = 30 bu. = the amount of corn.
5 parts = 50 bu. = the amount of rye.

Exercise 125, Page 273.

2. $\frac{2000}{4800} = \frac{5}{12}$ = the part of the farm the first owns.
$\frac{1500}{4800} = \frac{5}{16}$ = the part of the farm the second owns.
$\frac{1300}{4800} = \frac{13}{48}$ = the part of the farm the third owns.
$\therefore$ $\frac{5}{12}$ of $\$720 = \$300$ = the first's share of the gain.
$\frac{5}{16}$ of $\$720 = \$225$ = the second's share of the gain.
$\frac{13}{48}$ of $\$720 = \$195$ = the third's share of the gain.

3. The gain of each is the same part of the whole gain as the stock of each is of the whole stock.

∴ $\frac{250}{400}$, or $\frac{5}{8}$, of \$240 = \$150 = A's share of the gain.
And $\frac{150}{400}$, or $\frac{3}{8}$, of \$240 = \$90 = B's share of the gain.

4. \$600 + \$450 + \$65.75 = \$1115.75 = the gross income.
313 × \$1.50 = \$469.50 = M's wages.
\$469.50 + \$325 = \$794.50 = the expenses.
∴ \$1115.75 − \$794.50 = \$321.25 = the net income, or profit.
$\frac{300}{500}$, or $\frac{3}{5}$, of \$321.25 = \$192.75 = M's share of the profit.
$\frac{200}{500}$, or $\frac{2}{5}$, of \$321.25 = \$128.50 = N's share of the profit.

5. The amount each invested is the same part of the whole investment as each man's gain is of the whole gain.

∴ $\frac{1000}{2500}$, or $\frac{2}{5}$, of \$6000 = \$2400 = R's investment.
$\frac{1200}{2500}$, or $\frac{12}{25}$, of \$6000 = \$2880 = S's investment.
$\frac{300}{2500}$, or $\frac{3}{25}$, of \$6000 = \$720 = T's investment.

6. \$3000 − (\$1200 + \$800) = \$1000 = P's share of the gain.
$\frac{1200}{3000} = \frac{2}{5}$, of the whole capital = M's share of the capital.
$\frac{800}{3000} = \frac{4}{15}$ of the whole capital = N's share of the capital.
$\frac{1000}{3000} = \frac{1}{3}$ of the whole capital = P's share of the capital = \$5000.
∴ 3 × \$5000 = \$15000 = the capital.
$\frac{2}{5}$ of \$15000 = \$6000 = M's capital.
$\frac{4}{15}$ of \$15000 = \$4000 = N's capital.

7. The whole debt = \$8500.
Each of the creditors should receive the same part of the assets as his debt is of the whole debt.

∴ $\frac{4000}{8500}$, or $\frac{8}{17}$, of \$2557.75 = \$1203.65 = A's share of the assets.
$\frac{2500}{8500}$, or $\frac{5}{17}$, of \$2557.75 = \$752.28 = B's share of the assets.
$\frac{2000}{8500}$, or $\frac{4}{17}$, of \$2557.75 = \$601.82 = C's share of the assets.

8. $\frac{5000}{18900}$, or $\frac{50}{189}$, of the whole gain = A's gain.
$\frac{4000}{18900}$, or $\frac{40}{189}$, of the whole gain = B's gain.
$\frac{189}{189} - \frac{90}{189} = \frac{99}{189}$ of the whole gain = C's gain = \$198.
Whence, $\frac{189}{99}$ of \$198 = \$378 = the whole gain.
∴ $\frac{50}{189}$ of \$378 = \$100 = A's gain.
$\frac{40}{189}$ of \$378 = \$80 = B's gain.
$\frac{99}{189}$ of \$18900 = \$9900 = C's capital.

9. 75% of \$8560 = \$6420 = the amount to be distributed.
\$8000 + \$7000 = \$15000 = the capital.
$\therefore \frac{8000}{15000}$, or $\frac{8}{15}$, of \$6420 = \$3424 = what A should receive.
$\frac{7000}{15000}$, or $\frac{7}{15}$, of \$6420 = \$2996 = what B should receive.

10. \$10000 − (\$7000 + \$200) = \$2800 = the profits.
$\frac{1800}{7200}$, or $\frac{1}{4}$, of \$2800 = \$700 = what A should receive.
$\frac{2400}{7200}$, or $\frac{1}{3}$, of \$2800 = \$933$\frac{1}{3}$ = what B should receive.
$1 - (\frac{1}{4} + \frac{1}{3})$, or $\frac{5}{12}$, of \$2800 = \$1166$\frac{2}{3}$ = what C should receive.

12. Hall's gain = the gain on \$600 for 18 mo.
= the gain on \$10800 for 1 mo.
Mill's gain = the gain on \$800 for 12 mo.
= the gain on \$9600 for 1 mo.
$\therefore$ the total gain = the gain on \$20400 for 1 mo.
$\therefore$ \$510 = the gain on \$20400 for 1 mo.
Hall's gain = $\frac{10800}{20400}$, or $\frac{9}{17}$, of \$510 = \$270.
Mill's gain = $\frac{9600}{20400}$, or $\frac{8}{17}$, of \$510 = \$240.

13. M's gain = the gain on 10 × \$1200, or \$12000, for 1 mo.
N's gain = the gain on 9 × \$1500, or \$13500, for 1 mo.
P's gain = the gain on 12 × 100, or \$ 1200, for 1 mo.
$\therefore$ the whole gain = the gain on \$26700, for 1 mo.
$\therefore \frac{12000}{26700}$, or $\frac{120}{267}$, of \$2670 = \$1200 = M's gain.
$\frac{13500}{26700}$, or $\frac{135}{267}$, of \$2670 = \$1350 = N's gain.
$\frac{1200}{26700}$, or $\frac{12}{267}$, óf \$2670 = \$120 = P's gain.

14. $\frac{1}{8}$ of \$360 = \$45 = M's gain for 1 mo.
$\frac{1}{9}$ of \$450 = \$50 = N's gain for 1 mo.
$\frac{1}{12}$ of \$720 = \$60 = P's gain for 1 mo.
$\therefore$ The whole gain for 1 mo. = \$155.
$\therefore \frac{45}{155}$, or $\frac{9}{31}$, of \$3100 = \$900 = M's capital.
$\frac{50}{155}$, or $\frac{10}{31}$, of \$3100 = \$1000 = N's capital.
$\frac{60}{155}$, or $\frac{12}{31}$, of \$3100 = \$1200 = P's capital.

15.

$$\text{R's gain = the gain on} \left\{ \begin{array}{r} 12 \times \$2000, \text{ or } \$24000 \\ 6 \times \$3000, \text{ or } \underline{\$18000} \\ \text{or } \$42000 \end{array} \right\} \text{for 1 mo.}$$

$$\text{S's gain = the gain on} \left\{ \begin{array}{r} 12 \times \$1500, \text{ or } \$18000 \\ 5 \times \$1500, \text{ or } \underline{\$\ \ 7500} \\ \text{or } \$25500 \end{array} \right\} \text{for 1 mo.}$$

$$\therefore \text{ The total gain} = \text{the gain on} \left\{\begin{array}{r} \$42000 \\ \underline{\$25500} \\ \$67500 \end{array}\right\} \text{for 1 mo.}$$

$\therefore \frac{42000}{67500}$, or $\frac{420}{675}$, of \$1350 = \$840 = R's gain.
$\frac{25500}{67500}$, or $\frac{255}{675}$, of \$1350 = \$510 = S's gain.

16. A's share = the wages for 24×45 da. = 1080 da.
B's share = the wages for 40×25 da. = 1000 da.
C's share = the wages for 35×42 da. = $\underline{1470}$ da.
$\therefore$ \$355 = the wages for 3550 da.
$\therefore \frac{1080}{3550}$, or $\frac{108}{355}$, of \$355 = \$108 = A's share.
$\frac{1000}{3550}$, or $\frac{100}{355}$, of \$355 = \$100 = B's share.
$\frac{1470}{3550}$, or $\frac{147}{355}$, of \$355 = \$147 = C's share.

17. $\frac{1}{8}$ of \$800 = \$100 = R's gain for 1 mo.
$\frac{1}{10}$ of \$400 = \$ 40 = S's gain for 1 mo.
$\frac{1}{12}$ of \$600 = $\underline{\$\ 50}$ = T's gain for 1 mo.
$\therefore$ \$190 = the entire gain per month.

Their capitals are the same parts of the whole capital as their monthly gains are of the whole monthly gain.

$\therefore \frac{100}{190}$, or $\frac{10}{19}$, of \$19000 = \$10000 = R's capital.
$\frac{40}{190}$, or $\frac{4}{19}$, of \$19000 = \$4000 = S's capital.
$\frac{50}{190}$, or $\frac{5}{19}$, of \$19000 = \$5000 = T's capital.

Exercise 126, Page 276.

3. $10 \times 40¢ = 400¢$ = the cost of 10 lb. Japan tea.
$40 \times 35¢ = 1400¢$ = the cost of 40 lb. Formosa tea.
$80 \times 45¢ = 3600¢$ = the cost of 80 lb. Imperial tea.
$90 \times 28¢ = \underline{2520¢}$ = the cost of $\underline{90}$ lb. Ceylon tea.
$7920¢$ = the cost of 220 lb. of the mixture.
$\therefore 7920¢ \div 220 = 36¢$ = the average price per pound.

4. $25 \times \$1.25 = \$31.25$ = the wages of the 25 clerks.
$4 \times \$1.10 = \$\ 4.40$ = the wages of the 4 drivers.
$1 \times \$4.50 = \underline{\$\ 4.50}$ = the wages of the $\underline{1}$ foreman.
$\$40.15$ = the wages of the 30 men.
$\therefore \$40.15 \div 30 = \$1.34-$ = the average daily wage.

5. 84 × 5.25¢ = 441¢ = the cost of 84 lb. "Keystone A."
168 × 5.10¢ = 856.8¢ = the cost of 168 lb. "Centennial A."
252 × 5.20¢ = 1310.4¢ = the cost of 252 lb. "Franklin B."
126 × 5.05¢ = 636.3¢ = the cost of 126 lb. "Keystone B."
3244.5¢ = the cost of 630 lb. of the mixture.
∴ 3244.5¢ ÷ 630 = 5.15¢ = the average cost per pound.

6. 49 × 25¢ = 1225¢ = the cost of 49 lb. almonds.
5 × 12¢ = 60¢ = the cost of 5 lb. Brazils.
10 × 13¢ = 130¢ = the cost of 10 lb. filberts.
15 × 4¢ = 60¢ = the cost of 15 lb. pecans.
1475¢ = the cost of 79 lb. of the mixture.
∴ 1475¢ ÷ 79 = 18.67¢ = the average cost per pound.

8. 1 × $150 = $150 = the salary of 1 principal per month.
4 × $ 80 = $320 = the salary of 4 teachers per month.
10 × $ 60 = $600 = the salary of 10 teachers per month.
12 × $ 45 = $540 = the salary of 12 teachers per month.
6 × $ 40 = $240 = the salary of 6 teachers per month.
$1850 = the salary of 33 teachers per month.
$\therefore \$1850 \div 33 = \$56\frac{2}{33}$ = the average salary per month.

9. The attendance of
6 pupils for 20 da. = the attendance of 1 pupil for 120 da.
The attendance of
8 pupils for 19 da. = the attendance of 1 pupil for 152 da.
The attendance of
4 pupils for 18 da. = the attendance of 1 pupil for 72 da.
The attendance of
4 pupils for 17 da. = the attendance of 1 pupil for 68 da.
The attendance of
6 pupils for 16 da. = the attendance of 1 pupil for 96 da.
The attendance of
1 pupil for 12 da. = the attendance of 1 pupil for 12 da.
∴ The entire attendance in
20 da. = the attendance of 1 pupil for 520 da.
∴ 520 da. : 20 da. = 26 = the average number of pupils daily.

11. The use of $ 300 for 4 mo. = the use of $1 for 1200 mo.
The use of $ 600 for 6 mo. = the use of $1 for 3600 mo.
The use of $1000 for 10 mo. = the use of $1 for 10000 mo.
The use of $1900 for x mo. = the use of $1 for 14800 mo.
Whence, $x = 14800 \text{ mo.} \div 1900 = 7\frac{15}{19}$ mo.

12. A credit of $300 for 15 da. = a credit of $1 for 4500 da.
A credit of $250 for 30 da. = a credit of $1 for 7500 da.
A credit of $160 for 60 da. = a credit of $1 for 9600 da.

∴ On Jan. 4 Richards had a credit = to the credit of $1 for 21600 da. But his debt was $710.

∴ 21600 da. ÷ 710 = 31 da.− = his average credit on $710.

∴ The entire bill was due 31 da. after Jan. 4, or on Feb. 4.

13. On Jan. 1, Mr. Smith was entitled to the use of $600 for 6 mo., or the use of $1 for 3600 mo.

$300 he used for 2 mo., which was equivalent to using $1 for 600 mo. $200 more he used 4 mo., which was equivalent to using $1 for 800 mo. Therefore, he was still entitled to the use of $1 for 3600 mo. − (600 mo. + 800 mo.), or 2200 mo., or to the use of $100 (which is what he still owes) for 22 mo.

∴ The remainder is due 22 mo. after Jan. 1, or on Nov. 1 the following year.

14. The credit of $\frac{1}{3}$ of $6000, or $2000, for 0 mo. = the credit of $1 for 0 mo.
The credit of $\frac{1}{3}$ of $6000, or $2000, for 6 mo. = the credit of $1 for 12000 mo.
The credit of $\frac{1}{3}$ of $6000, or $2000, for 12 mo. = the credit of $1 for 24000 mo.
∴ Mr. Cloud's whole credit on Jan. 1 = the credit of $1 for 36000 mo.

Or the credit of $6000 for $\frac{1}{6000}$ of 36000 mo. = 6 mo.

∴ 6 mo. after Jan. 1, or July 1, was the date of payment.

Exercise 129, Page 282.

13.

```
       25'80'64 |508
       25
     -------
10     | 80
1008   | 8064
       | 8064
```

15.

```
       36'36'09 |603
       36
     -------
12     | 36
1203   | 3609
       | 3609
```

17.

```
     49'84'36 | 706
     49
14      | 84
1406    | 8436
        | 8436
```

19.

```
     64'32'04 | 802
     64
16      | 32
1602    | 3204
        | 3204
```

21.

```
     82'44'64 | 908
     81
18      | 144
1808    | 14464
        | 14464
```

27.

```
     32.00'00'00 | 5.656+
     25            5.66− Ans.
106     | 700
        | 636
1125    |  6400
        |  5625
11306   |   77500
        |   67836
```

28.

```
     45.00'00'00 | 6.708
     36            6.71− Ans.
127     | 900
        | 889
134     |  1100
13408   |  110000
        |  104264
```

29.

```
     3'21.00'00'00 | 17.916
     1               17.92− Ans.
27      | 221
        | 189
349     |  3200
        |  3141
3581    |   5900
        |   3581
35826   |   231900
        |   214956
```

30.

```
     5'08.00'00'00 | 22.538
     4               22.54− Ans.
42      | 108
        |  84
445     |  2400
        |  2225
4503    |   17500
        |   13509
45068   |    399100
        |    360544
```

31.

```
     3.42'00'00 | 1.85− Ans.
     1
28      | 242
        | 224
365     |  1800
        |  1825
```

32.

```
     1.42'30'00 | 1.191
     1            1.19+ Ans.
21      | 42
        | 21
229     | 2100
        | 2061
2381    |  3900
        |  2381
```

33.

$$\begin{array}{r|l} & .02'30'00 \;\underline{|\;.151} \\ & \underline{1} \qquad\quad .15+ \;\; \textit{Ans.} \\ 25 & 130 \\ & \underline{125} \\ 301 & \;\;500 \\ & \;\;\underline{301} \end{array}$$

34.

$$\begin{array}{r|l} & .00'21'00 \;\underline{|\;.046-} \\ & \underline{16} \qquad\quad .05+ \;\; \textit{Ans.} \\ 86 & 500 \\ & \underline{516} \end{array}$$

39. $\sqrt{7\frac{1}{9}} = \sqrt{\frac{64}{9}} = \frac{8}{3} = 2\frac{2}{3}$.

40. $\sqrt{6\frac{112}{289}} = \sqrt{\frac{1846}{289}} = \frac{43}{17} = 2\frac{9}{17}$.

41.

$\frac{7}{8} = .875$

$$\begin{array}{r|l} & .87'50'00 \;\underline{|\;.935+} \\ & \underline{81} \qquad\quad .94- \;\; \textit{Ans.} \\ 183 & 650 \\ & \underline{549} \\ 1865 & 10100 \\ & \;\underline{9325} \end{array}$$

42.

$\frac{16}{3} = 5.333333+$

$$\begin{array}{r|l} & 5.33'33'33 \;\underline{|\;2.309+} \\ & \underline{4} \qquad\quad 2.31- \;\; \textit{Ans.} \\ 43 & 133 \\ & \underline{129} \\ 46 & \;\;\underline{433} \\ 4609 & \;\;43333 \\ & \;\;\underline{41481} \end{array}$$

Exercise 130, Page 285.

10.

$$\begin{array}{r|l} & 28'09'44'64 \;\underline{|\;304} \\ & \underline{27} \\ \underline{3 \times 3^2 = 27} & \underline{1094} \\ 3 \times \overline{30}^2 = 2700 & 1094464 \\ 3 \times 30 \times 4 = \;\;\; 360 & \\ 4^2 = \;\;\;\; \underline{16} & \\ \underline{273616} & \underline{1094464} \end{array}$$

12.

$$\begin{array}{r|l} & 131'096'512 \;\underline{|\;508} \\ & \underline{125} \\ \underline{3 \times 5^2 = 75} & \underline{6096} \\ 3 \times \overline{50}^2 = 7500 & 6096512 \\ 3 \times 50 \times 8 = \;\; 1200 & \\ 8^2 = \;\;\;\; \underline{64} & \\ \underline{762064} & \underline{6096512} \end{array}$$

23.

$25.000'000'000 \mid \underline{2.924}$

8 2.92+ *Ans.*

$$\begin{array}{r|l}
3 \times 2^2 = 12 & 17000 \\
3 \times 2 \times 9 = \ \ 54 & \\
9^2 = \ \ 81 & \\
\underline{1821} & \underline{16389} \\
3 \times \overline{29}^2 = 2523 & 611000 \\
3 \times 29 \times 2 = \ \ 174 & \\
2^2 = \ \ 4 & \\
\underline{254044} & \underline{508088} \\
3 \times \overline{292}^2 = 255792 & 102912000 \\
3 \times 292 \times 4 = \ \ 3504 & \\
4^2 = \ \ 16 & \\
\underline{25614256} & \underline{102457024}
\end{array}$$

24.

$126.000'000'000 \mid \underline{5.013}$

$\underline{125}$ 5.01 *Ans.*

$$\begin{array}{r|l}
\underline{3 \times 5^2 = 75} & \underline{1000} \\
3 \times \overline{50}^2 = 7500 & 1000000 \\
3 \times 50 \times 1 = \ \ 150 & \\
1^2 = \ \ 1 & \\
751501 & \underline{751501} \\
\underline{3 \times \overline{501}^2 = 251001 = 753003} & \underline{248499000}
\end{array}$$

25.

$4.500'000'000' \mid \underline{1.650}$

1 1.65+ *Ans.*

$$\begin{array}{r|l}
3 \times 1^2 = 3 & 3500 \\
3 \times 1 \times 6 = 18 & \\
6^2 = \ \ 36 & \\
\underline{516} & \underline{3096} \\
3 \times \overline{16}^2 = 768 & 404000 \\
3 \times 16 \times 5 = \ \ 240 & \\
5^2 = \ \ 25 & \\
79225 & \underline{396125} \\
\underline{3 \times \overline{165}^2 = 81675} & \underline{7875000}
\end{array}$$

26.

	3.750′000′000	1.553
	1	1.55 *Ans.*
$3 \times 1^2 = 3$	2750	
$3 \times 1 \times 5 = 15$		
$5^2 = 25$		
475	2375	
$3 \times \overline{15}^2 = 675$	375000	
$3 \times 15 \times 5 = 225$		
$5^2 = 25$		
69775	348875	
$3 \times \overline{155}^2 = 72075$	26125000	

27.

	300.000′000′000	6.694
	216	6.69+ *Ans.*
$3 \times 6^2 = 108$	84000	
$3 \times 6 \times 6 = 108$		
$6^2 = 36$		
11916	71496	
$3 \times \overline{66}^2 = 13068$	12504000	
$3 \times 66 \times 9 = 1782$		
$9^2 = 81$		
1324701	11922309	
$3 \times \overline{669}^2 = 1342683$	581691000	

28.

	.005′000′000	.171−
	1	.17+ *Ans.*
$3 \times 1^2 = 3$	4000	
$3 \times 1 \times 7 = 21$		
$7^2 = 49$		
559	3913	
$3 \times \overline{17}^2 = 867$	87000	

29.

$$\begin{array}{rr|l}
\multicolumn{3}{r}{.800'000'000\ \lfloor\underline{.928-}} \\
\multicolumn{3}{r}{\underline{729} \qquad .93-\ \textit{Ans.}} \\
3\times 9^2 = & 243 & 71000 \\
3\times 9\times 2 = & 54 & \\
2^2 = & \underline{4} & \\
 & \underline{24844} & \underline{49688} \\
3\times\overline{92}^2 = & 25392 & 21312000
\end{array}$$

30.

$$\begin{array}{rr|l}
\multicolumn{3}{r}{.270'000'000\ \lfloor\underline{.646+}} \\
\multicolumn{3}{r}{\underline{216} \qquad .65-\ \textit{Ans.}} \\
3\times 6^2 = & 108 & 54000 \\
3\times 6\times 4 = & 72 & \\
4^2 = & \underline{16} & \\
 & \underline{11536} & \underline{46144} \\
3\times\overline{64}^2 = & 12288 & 7856000
\end{array}$$

35. $\sqrt[3]{12\frac{19}{27}} = \sqrt[3]{\frac{343}{27}} = \frac{\sqrt[3]{343}}{\sqrt[3]{27}} = \frac{7}{3} = 2\frac{1}{3}.$

36. $\sqrt[3]{5\frac{104}{125}} = \sqrt[3]{\frac{729}{125}} = \frac{\sqrt[3]{729}}{\sqrt[3]{125}} = \frac{9}{5} = 1\frac{4}{5}.$

37.

$$\begin{array}{rr|l}
\multicolumn{3}{r}{\tfrac{3}{5} = .600'000'000\ \lfloor\underline{.843}} \\
\multicolumn{3}{r}{\underline{512} \qquad .84+\ \textit{Ans.}} \\
3\times 8^2 = & 192 & 88000 \\
3\times 8\times 4 = & 96 & \\
4^2 = & \underline{16} & \\
 & \underline{20176} & \underline{80704} \\
3\times\overline{84}^2 = & 21168 & 7296000
\end{array}$$

38.

$$\begin{array}{rr|l}
\multicolumn{3}{r}{\tfrac{2}{7} = .285'714'285\ \lfloor\underline{.658}} \\
\multicolumn{3}{r}{\underline{216} \qquad .66-\ \textit{Ans.}} \\
3\times 6^2 = & 108 & 69714 \\
3\times 6\times 5 = & 90 & \\
5^2 = & \underline{25} & \\
 & \underline{11725} & \underline{58625} \\
3\times\overline{65}^2 = & 12675 & 11089285
\end{array}$$

Exercise 131, Page 292.

1. $180° - (36° + 59°) = 85°$ = the remaining angle [§ 380, 1].

2. $180° - (50° + 50°) = 80°$ = the angle at the vertex [§ 380, 1].

3. $180° - 50° = 130°$ = twice each angle at the base [§ 380, 2].
Whence, $\frac{1}{2}$ of $130° = 65°$ = each angle at the base.

4. $\frac{1}{2}$ of 36 ft. = 18 ft. = the altitude [§ 380, 5].

5. $180° - (90° + 42° 15') = 47° 45'$ = the other acute angle.

6. The sum of the two acute angles $= 90°$.
$\therefore$ 4 times the smaller $= 90°$; whence the smaller $= 22° 30'$.
And the larger $= 3 \times 22° 30' = 67° 30'$.

7. $\angle A + \angle B + \angle C = 180°$ (§ 380, 1).
But $\angle A = 2\angle B = 3\angle C$; whence, $\angle B = \frac{3}{2}\angle C$.
$\therefore 3\angle C + \frac{3}{2}\angle C + \angle C = \frac{11}{2}\angle C = 180°$.
Whence, $\angle C = \frac{2}{11}$ of $180° = 32\frac{8}{11}°$.
$\angle B = \frac{3}{2}\angle C = \frac{3}{2}$ of $\frac{2}{11}$ of $180° = 49\frac{1}{11}°$.
And $\angle A = 3\angle C = 3 \times \frac{2}{11}$ of $180° = 98\frac{2}{11}°$.

8. $h^2 = \overline{36}^2 + \overline{48}^2 = 1296 + 2304 = 3600$.
Whence, $\sqrt{3600} = 60$ = the number of feet in the hypotenuse.

9. Here the hypotenuse = 35 ft., the base = 21 ft., to find the perpendicular.
$\overline{\text{Perpendicular}}^2 = \overline{\text{hypotenuse}}^2 - \overline{\text{base}}^2 = \overline{35}^2 - \overline{21}^2 = 784$.
Whence, perpendicular $= \sqrt{784} = 28$.
$\therefore$ the ladder reaches 28 ft. up the house.

10. Here the perpendicular = 52 ft., the base = 39 ft., to find the hypotenuse. $h^2 = p^2 + b^2 = \overline{52}^2 + \overline{39}^2 = 4225$.
Whence, $h = \sqrt{4225} = 65$.
$\therefore$ the length of the rope = 65 ft.

11. Use Fig. 2, § 382, and suppose $\angle B$ a right angle.
Given $BD = 32$, $AD = 36$, and $CD = 24$.
$\overline{AB}^2 = \overline{BD}^2 + \overline{AD}^2 = \overline{32}^2 + \overline{36}^2 = 1024 + 1296 = 2320$.
Whence, $AB = \sqrt{2320} = 48.17$.
$\overline{BC}^2 = \overline{BD}^2 + \overline{CD}^2 = \overline{32}^2 + \overline{24}^2 = 1600$.
Whence, $BC = \sqrt{1600} = 40$.
$\therefore$ the legs are 48.17 ft. and 40 ft. long.

13. Use Fig. 2, § 382. Given $BC = 42$, $AB = 50$, and $BD = 30$.
$\overline{AD}^2 = \overline{AB}^2 - \overline{BD}^2 = \overline{50}^2 - \overline{30}^2 = 1600$; whence, $AD = 40$.
$\overline{CD}^2 = \overline{BC}^2 - \overline{BD}^2 = \overline{42}^2 - \overline{30}^2 = 864$; whence, $CD = 29.394$.
$\therefore\ AC = AD + CD = 40 + 29.394 = 69.394$.
$\therefore$ the stakes are 69.394 ft. apart.

14. $\frac{1}{2}$ of $16 \times 10 = 80$ = the number of square chains in the lot [§ 382].
$\therefore\ 80 : 10 = 8$ = the number of acres in the lot.

15. $\frac{1}{2}$ of $(13 + 14 + 15) = 21$ = the number of rods in $\frac{1}{2}$ the perimeter.
Whence, $\sqrt{21 \times (21 - 13) \times (21 - 14) \times (21 - 5)} = 84$ = the number of square rods in the lot [§ 383, R.].
$\therefore$ the area of the lot = 84 sq. rd.

16. Use Fig. 4, § 373. $\angle B = 30°$, $BD = \frac{1}{2} BC$ [§ 380, 4].
$AD = \frac{1}{2} AB = \frac{1}{2}$ of $40 = 20$ [§ 380, 5].
$\overline{BD}^2 = \overline{AB}^2 - \overline{AD}^2 = \overline{40}^2 - \overline{20}^2 = 1200$; whence, $BD = \sqrt{1200} = 34.641$.
And $BC = 2\,BD = 69.282$.
$\frac{1}{2}$ of $AD \times BC = \frac{1}{2}$ of $20 \times 69.282 = 692.82$ = the number of square feet in the triangle [§ 382].
$\therefore$ the area of the triangle = 692.82 sq. ft.

17. Use Fig. 4, § 373. $\angle B = 30°$, $AD = \frac{1}{2} AB = 48$ [§ 380, 5].
Whence, $AB = 96$. $\overline{BD}^2 = \overline{AB}^2 - \overline{AD}^2 = \overline{96}^2 - \overline{48}^2 = 6912$.
$\therefore\ BD = \sqrt{6912} = 83.1384$.
Now, $\frac{1}{2} AD \times BC = AD \times BD = 48 \times 83.1384 = 3990.64$ = the number of square feet in the triangle [§ 382].
$\therefore$ the area of the triangle = 3990.64 sq. ft.

18. Use Fig. 5, § 373. $AB = BC = AC = 5$.
$BD = DC = \frac{5}{2}$ [§ 380, 4].
$\overline{AD}^2 = \overline{AB}^2 - \overline{BD}^2 = 5^2 - (\frac{5}{2})^2 = \frac{75}{4}$. Whence, $AD = \frac{1}{2}\sqrt{75} = 4.33$.
$\therefore\ \frac{1}{2}$ of $AD \times BC = AD \times BD = 4.33 \times \frac{5}{2} = 10.83-$ = the number of square rods in the triangle [§ 382].
$\therefore$ the area of the triangle = 10.83− sq. rd.

19. $\frac{1}{2}$ of $18 \times 25 = 225$ = the number of square feet in the area of each figure.
Whence, $\sqrt{225} = 15$ = the number of feet in each side of the square.
$\therefore$ 15 ft. = the length of one side of the square.

20. Let x = the number of feet in the altitude.
Now, $\frac{1}{2}$ of $x \times 18 = 9x = 436$ [§ 382]. Whence, $x = 48\frac{4}{9}$.
$\therefore$ the altitude = $48\frac{4}{9}$ ft.

21. 60 sq. rd. = 1815 sq. yd. Let x = the number of yards in the base.

Now, ½ of $12 \times x = 6x = 1815$ [§ 382]. Whence, $x = 302\frac{1}{2}$.

∴ the base = 302½ yd. = 907½ ft.

22. Let x = the number of feet in the altitude of 1st triangle.

Then, ½ of $x \times 16$ = ½ of $9 \times 12 = 54$ [§ 382].

Whence, $8x = 54$, and $x = 6\frac{3}{4}$.

∴ the altitude of the first triangle = 6¾ ft.

23. $\overline{50}^2 - \overline{30}^2 = 1600 =$ the $\overline{\text{base}}^2$. Whence, the base = 40.

Now, ½ of $30 \times 40 = 600$ = the number of square chains in the area.

Whence, $600 : 10 = 60$ = the number of acres in the area.

∴ the area of the triangle = 60 A.

24. $\sqrt{225} = 15$ = the number of yards in the hypotenuse.

$\sqrt{144} = 12$ = the number of yards in the base.

$\overline{\text{Altitude}}^2 = \overline{\text{hypotenuse}}^2 - \overline{\text{base}}^2 = \overline{15}^2 - \overline{12}^2 = 81$. Whence, altitude = 9.

Whence, ½ of $9 \times 12 = 54$ = the number of square yards in the area.

∴ the area = 54 sq. yd.

Exercise 132, Page 298.

1. $\angle C = \angle A = 48°$ [§ 392, 2].

$\angle A + \angle D = 180°$ [§ 392, 3].

Whence, $\angle D = 180° - \angle A = 180° - 48° = 132°$.

$\angle B = \angle D = 132°$.

2. $\overline{\text{Diagonal}}^2 = \overline{\text{base}}^2 + \overline{\text{altitude}}^2 = \overline{48}^2 + \overline{36}^2 = 3600$.

Whence, diagonal $= \sqrt{3600} = 60$.

∴ the length of the diagonal = 60 ft.

3. $\overline{\text{Altitude}}^2 = \overline{\text{diagonal}}^2 - \overline{\text{base}}^2 = \overline{65}^2 - \overline{52}^2 = 1521$.

Whence, altitude $= \sqrt{1521} = 39$.

Now, $39 \times 52 = 2028$ = the number of square feet in the area [§ 194]

∴ the altitude = 39 ft., and the area = 2028 sq. ft.

4. Use Fig. 5 [§ 387]. $DE = \frac{1}{2} DB = \frac{1}{2}$ of $32 = 16$.

And $CE = \frac{1}{2} AC = \frac{1}{2}$ of $24 = 12$ [§ 392, 4].

DEC is a right triangle [§ 392, 7].

Now, $\overline{DC}^2 = \overline{DE}^2 + \overline{EC}^2 = \overline{16}^2 + \overline{12}^2 = 400$.

Whence, $DC = \sqrt{400} = 20$.

½ of $AC \times BD = \frac{1}{2}$ of $32 \times 24 = 384$ = the number of square yards in the area [§ 394].

∴ the side = 20 yd., and the area = 384 sq. yd.

5. $\overline{\text{Diagonal}}^2 = \overline{\text{side}}^2 + \overline{\text{side}}^2 = 2\,\overline{\text{side}}^2 = 2 \times \overline{23}^2 = 1058$.
Whence, diagonal $= \sqrt{1058} = 32.53-$.
$\therefore$ the length of the diagonal = 32.53 ft.

6. $\overline{\text{Diagonal}}^2 = \overline{36}^2 = 2 \times \overline{\text{side}}^2$.
Whence, $\overline{\text{side}}^2 = \frac{1}{2}$ of $\overline{36}^2 = 18 \times 36 = 648$.
$\therefore$ the area = 648 sq. ft.
Side $= \sqrt{648} = 25.46$.
$\therefore$ the length of a side = 25.46 ft.

7. $28 \times 36 = 1008$ = the number of square chains in the area [§ 393].
Whence, $1008 : 10 = 100.8$ = number of acres in the area.
$\therefore$ the area = 100.8 A.

8. Let x = the number of rods in the altitude.
Now, $x \times 60 = 180$ [§ 393]. Whence, $x = 3$.
$\therefore$ the altitude = 3 rd.

9. Area = 9 A. 96 P. = 1536 sq. rd. Let x = the number of rods in the base.
Now, $32 \times x = 1536$ [§ 393]. Whence, $x = 48$.
$\therefore$ the base = 48 rd.

10. 2 × length + 2 × width = 112 ft.
$\therefore$ the length + the width = 56 ft.
$\therefore$ the length + 24 ft. = 56 ft.
Whence, the length = 56 ft. − 24 ft. = 32 ft.
Now, $24 \times 32 = 768$ = the number of square feet in the area.
$\overline{\text{Diagonal}}^2 = \overline{\text{length}}^2 + \overline{\text{width}}^2 = \overline{32}^2 + \overline{24}^2 = 1600$.
Whence, the diagonal = 40.
$\therefore$ the area = 768 sq. ft., and the length of the diagonal = 40 ft.

11. Use Fig. 8, § 393. Suppose it to be a rhombus.
$\angle A = 30°$. $AD = 48$. $DE = \frac{1}{2} AD = \frac{1}{2}$ of $48 = 24$ [§ 380, 5].
Now, $24 \times 48 = 1152$ = the number of square feet in the area [§ 393].
$\therefore$ the area = 1152 sq. ft.

12. Use Fig. 9, § 394.
$\frac{1}{2}$ of $BD \times AC = 5 \times AC = 90$ [§ 394].
Whence, $AC = \frac{1}{5}$ of $90 = 18$.
$\therefore$ the diagonal AC = 18 rd.

13. 1 A. = 160 sq. rd. = 4840 sq. yd.
$\therefore \sqrt{4840} = 69.57$ = the number of yards in one side.
$\therefore$ the length of one side = 69.57 yd.

14. Use Fig. 10, § 395.

$\frac{1}{2}(AB + DC) \times DE = \frac{1}{2}(24 + 18) \times 9 = 189$ = the number of square feet in the area [§ 395].

$\therefore$ the area = 189 sq. ft.

15. $\frac{1}{2}$ of $DE \times AC = \frac{1}{2}$ of $2 \times 10 = 10$ = the number of square feet in $\triangle ADC$.

$\frac{1}{2}$ of $BF \times AC = \frac{1}{2}$ of $6 \times 10 = 30$ = the number of square feet in $\triangle ABC$ [§ 382].

$\therefore$ the area of $ABCD$ = 10 sq. ft. + 30 sq. ft. = 40 sq. ft.

16. The diagonal divides the tract into two triangles.

$\frac{1}{2}$ of $(14 + 18 + 30) = 31 = \frac{1}{2}$ of the perimeter of one triangle.

$\frac{1}{2}$ of $(20 + 22 + 30) = 36 = \frac{1}{2}$ of the perimeter of the other triangle.

Now, $\sqrt{31 \times (31 - 14)(31 - 18)(31 - 30)} = \sqrt{6851} = 82.77$ = the number of square chains in the first triangle.

And $\sqrt{36 \times (36 - 20)(36 - 22)(36 - 30)} = \sqrt{48384} = 219.96$ = the number of square chains in the second triangle.

$\therefore$ the area of the tract = 82.77 sq. ch. + 219.96 sq. ch. = 302.73 sq. ch. = 30 A. 273 sq. ch.

17. $\frac{1}{2}$ of (18 in. + 14 in.) = 16 in. = the average width of the board.

Now, $\frac{16 \times 16}{12} = 21\frac{1}{3}$ = the number of board feet in the board [§ 237].

18. The bases of the trapezoid are 8 ft. and 6 ft., and the altitude is 40 ft.

$\therefore \frac{1}{2}$ of $40 \times (8 + 6) = 20 \times 14 = 280$ = the number of square feet in the face of the wall [§ 395].

19. AB = 18 ft. $BC = DE = 4\frac{1}{2}$ ft.

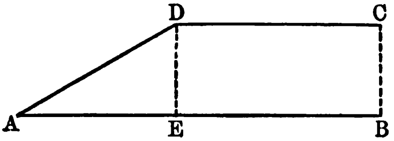
$AD = 2 \times DE = 2 \times 4\frac{1}{2}$ ft. = 9 ft. [§ 380, 5].

$\overline{AE}^2 = \overline{AD}^2 - \overline{DE}^2 = 9^2 - (\frac{9}{2})^2 = \frac{243}{4} = 60.75$.

Whence, $\sqrt{60.75} = 7.794$ = the number of feet in AE.

Now, $18 - 7.794 = 10.206$ = the number of feet in EB.

$BC \times EB = 4\frac{1}{2} \times 10.206 = 45.927$ = the number of square feet in $DEBC$.



$\frac{1}{2}$ of $DE \times AE = 2\frac{1}{4} \times 7.794 = 17.536$ = the number of square feet in DAE.

$\therefore$ the area of $ABCD = 45.927$ sq. ft. + 17.536 sq. ft. = 63.463 sq. ft. = 7.05 sq. yd.

20. 5 A. = 800 sq. rd. = 24200 sq. yd. = 217800 sq. ft.

Let x = the number of feet in the width.

Then, $\frac{3}{2}x$ = the number of feet in the length.

$\therefore x \times \frac{3}{2}x = \frac{3}{2}x^2 = 217800.$

Whence, $x^2 = \frac{2}{3}$ of $217800 = 145200$.

And $x = \sqrt{145200} = 381.05$ = the number of feet in the width.

And $\frac{3}{2}x = \frac{3}{2}$ of $381.05 = 571.58$ = the number of feet in the length.

Now, $2 \times (381.05 + 571.58) = 1905.26$ = the number of feet in the perimeter.

Whence, $1905.26 : 8 = 239-$ = the number of panels.

21. Use Fig. 9, § 394. $AB = 1$. $BD = 1$. $BE = \frac{1}{2}$. ABE is a rt. △ [§ 392, 7].

$\overline{AE}^2 = \overline{AB}^2 - \overline{BE}^2 = 1^2 - (\frac{1}{2})^2 = .75$; whence, $AE = \sqrt{.75} = .866$. $AC = 1.732$.

Now, $\frac{1}{2}$ of $1 \times 1.732 = .87-$ = the number of square feet in the area [§ 394].

22. Let x = the number of feet in the altitude required.

Now, $x \times 36 = 24 \times 32$ [§ 194].

Whence, $x = \frac{24 \times 32}{36} = 21\frac{1}{3}$.

$\therefore$ the altitude = $21\frac{1}{3}$ ft.

23. $\frac{1}{2}$ of $8 \times (16 + 9) = 100$ = the number of square feet in the area of each.

$\therefore \sqrt{100} = 10$ = the number of feet in each side of the square.

24. $2 \times 14 \times 50 = 1400$ = the number of square feet in the roof.

Whence, 14 = the number of squares of 100 sq. ft. each.

$\therefore 14 \times \$7 = \$98$ = the cost of slating.

25. $\frac{1}{2}$ of $(13 + 14 + 15) = 21$ = the number of rods in $\frac{1}{2}$ the perimeter of each triangle.

Whence, $\sqrt{21 \times (21 - 13) \times (21 - 14) \times (21 - 15)} = \sqrt{3^2 \times 7^2 \times 4 \times 2^2} = 84$ = the number of square rods in each triangle.

$\therefore$ the area of the polygon = 3×84 sq. rd. = 252 sq. rd.

26. The bases of the trapezoid are 24.80 ch. and 18.40 ch., and the altitude = 12.60 ch.

Now, $\frac{1}{2}$ of 12.60 × (24.80 + 18.40) = 272.16 = the number of square chains in the field [§ 395].

∴ the area = 272.16 sq. ch. = 27.216 A.

27. $\frac{1}{2}$ of 2 × 2 = 2 = the number of square chains in $\triangle\, ABG$.

$\frac{1}{2}$ of 4 × (3 + 2) = 10 = the number of square chains in $GBCH$.

$\frac{1}{2}$ of 3 × 3 = $4\frac{1}{2}$ = the number of square chains in $\triangle\, CHD$.

$\frac{1}{2}$ of 3 × 1 = $1\frac{1}{2}$ = the number of square chains in $\triangle\, DEL$.

$\frac{1}{2}$ of 8 × 3 = 12 = the number of square chains in $\triangle\, AEL$.

∴ the area of the polygon = $(2 + 10 + 4\frac{1}{2} + 1\frac{1}{2} + 12)$ sq. ch. = 30 sq. ch. = 3 A.

28. $\frac{1}{2}$ of 2 × 4 = 4 = the number of square inches in each trapezoid.

29. Use Fig. 9, § 394. $AC = 8$. $BD = 6$.

Now, $AE = \frac{1}{2}\,AC = 4$. $BE = \frac{1}{2}\,BD = 3$ [§ 392, 4].

AEB is a right triangle [§ 392, 7].

Now, $\overline{AB}^2 = \overline{AE}^2 + \overline{BE}^2 = 16 + 9 = 25$. Whence, $AB = 5$.

And $4\,AB = 4 \times 5 = 20$.

∴ the perimeter = 20 ft.

30. Use Fig. 11, § 396. $AC = 24^{\text{m}}$. $BF = 86^{\text{m}}$. $DE = 42^{\text{m}}$.

Now, $\frac{1}{2}$ of 24 × 42 = 504 = the number of square meters in $\triangle\, DAC$.

$\frac{1}{2}$ of 24 × 86 = 1032 = the number of square meters in $\triangle\, BAC$.

∴ the area = $(504 + 1032)^{\text{qm}} = 1536^{\text{qm}} = 15.36^{\text{a}}$.

Exercise 133, Page 302.

In the following solutions : —

a = the number of units in the apothem.
s = the number of units in a side.
p = the number of units in the perimeter.
r = the number of units in the radius.
d = the number of units in the diameter.
c = the number of units in the circumference.
A = the number of square units in the area.

1. See Fig., § 397. $FG = \frac{1}{2}$ of FE [§ 380, 4] $= \frac{1}{2}\,s$.

$s = 5 = r$ [§ 398, 4]. $p = 6\,s = 30$.

In rt. $\triangle\, OGE$, $a^2 = r^2 - \frac{1}{2}\,s^2 = 25 - \frac{25}{4} = \frac{75}{4} = 18.75$ [§ 380, 7].

Whence, $a = \sqrt{18.75} = 4.33$.
$A = \frac{1}{2}\, a \times p$ [§ 399] $= \frac{1}{2}$ of $4.43 \times 30 = 64.95$.
∴ the area = 64.95 sq. ft.

2. See Fig., § 397. $FG = \frac{1}{2}$ of FE [§ 380, 4].
$r = 6 = s$ [§ 398, 4]. $p = 6\, s = 6 \times 6 = 36$.
In rt. △ OGE, $a^2 = r^2 - \frac{1}{2}\, s^2 = 6^2 - 3^2 = 27$ [§ 380, 7].
Whence, $a = \sqrt{27} = 5.196$.
$A = \frac{1}{2}\, a \times p$ [§ 399] $= \frac{1}{2}$ of $5.196 \times 36 = 93.53$.
∴ the area = 93.53 sq. yd.

3. See Fig., § 397. $a = 8 = \frac{1}{2}\sqrt{3} \times r$ [§ 398, 5] $= \frac{1}{2}\sqrt{3} \times s$ [§ 398, 4].
∴ $r = s = a \div \frac{1}{2}\sqrt{3} = 8 \div \frac{1}{2}\sqrt{3} = 8 \div .866 = 9.238-$.
$p = 6\, s = 6 \times 9.238 = 55.428$.
$A = \frac{1}{2}\, a \times p$ [§ 399] $= 4 \times 55.428 = 221.7$.
∴ the area = 221.7 sq. rd.

4. $s = r = 11.76$ [§ 398, 4]. $p = 5\, s = 5 \times 11.76 = 58.8$.
$A = \frac{1}{2}\, a \times p$ [§ 399] $= \frac{1}{2}$ of $8.09 \times 58.8 = 237.85-$.
∴ the area = 237.85 sq. ft.

5. $s = r = 3.83$ [§ 398, 4]. $p = 8\, s = 8 \times 3.83 = 30.64$.
$A = \frac{1}{2}\, a \times p$ [§ 399] $= \frac{1}{2}$ of $4.62 \times 30.64 = 70.78$.
∴ the area = 70.78 sq. yd.

6. $A = \frac{22}{7} \times r^2 = 113\frac{1}{7}$ [§ 245, 4].
∴ $r^2 = 113\frac{1}{7} \div \frac{22}{7} = \frac{7}{22}$ of $\frac{792}{7} = 36$. Whence, $r = \sqrt{36} = 6$.
∴ the radius = 6 ft.

7. ABC is a right triangle. $\overline{AC}$ = the diameter $= d$, $AB = BC = s$.
$\overline{AB}^2 + \overline{BC}^2 = \overline{AC}^2$ [§ 380, 6], or $s^2 + s^2 = d^2 = 16^2 = 256$.
Whence, $2\, s^2 = 256$. And $s^2 = 128$.
∴ $s = \sqrt{128} = 11.31$. ∴ the side = 11.31 in.

8. $s = 11.31$ [*Ans.* Ex. 7].
$4\, s = p = 4 \times 11.31 = 45.24$.
∴ the perimeter of the square = 45.24 in.
$c = \frac{22}{7} \times d$ [§ 245, 2] $= \frac{22}{7} \times 16 = 50.28$.
∴ the circumference = 50.28 in.
Whence, 50.28 in. − 45.24 in. = 5.04 in. = the difference.

9. In Fig., Ex. 7, $2\, s^2 = d^2 = 16^2 = 256$ [§ 380, 6].
Whence, $s^2 = \frac{1}{2}$ of $256 = 128 = A$ [§ 190].
∴ the area of the square = 128 sq. in.
In the circle $r = \frac{1}{2}\, d = 8$ [§ 245, 1].

$A = \frac{22}{7} \times r^2$ [§ 245, 4] $= \frac{22}{7} \times 8^2 = 201.14$.
∴ the area of the circle = 201.14 sq. in.
Whence, 201.14 sq. in. − 128 sq. in. = 73.14 sq. in. = the difference.

10. AB = the diameter = 8 ft.
4 × 8 ft., or 32 ft. = the perimeter.
$A = s^2 = 8^2 = 64$ [§ 190].
∴ the area = 64 sq. ft.

11. AB = the diameter = 12 ft. ∴ $s = 12$.
$p = 4\,s = 4 \times 12$, or 48. Whence, the perimeter = 48 ft.
$c = \frac{22}{7} \times d = \frac{22}{7} \times 12 = 37\frac{5}{7}$ [§ 245, 2].
Whence, the circumference = $37\frac{5}{7}$ ft.
∴ 48 ft. − $37\frac{5}{7}$ ft. = $10\frac{2}{7}$ ft. = the difference.

12. $A = s^2 = \overline{10}^2 = 100$. Whence, the area of the square = 100 sq. ft.
In the circle $r = \frac{1}{2}\,d = 5$.
$A = \frac{22}{7} \times r^2 = \frac{22}{7} \times 5^2 = 78\frac{4}{7}$ [§ 245, 4].
∴ the area of the circle = $78\frac{4}{7}$ sq. ft.
Whence, 100 sq. ft. − $78\frac{4}{7}$ sq. ft. = $12\frac{3}{7}$ sq. ft. = the difference.

13. See Fig., Ex. 7. $\overline{AC} = 20$ in. = the diameter.
$s^2 + s^2$, or $2\,s^2 = d^2 = 400$ [§ 380, 6].
Whence, $s^2 = A = 200$ [§ 190].
∴ the area of the square = 200 sq. in.

14. See Fig., Ex. 10. Here $d = 15$; whence, $r = \frac{15}{2}$
$A = \frac{22}{7} \times r^2 = \frac{22}{7} \times \frac{225}{4} = 176\frac{11}{14}$ [§ 245, 4].
∴ the area of the circle = $176\frac{11}{14}$ sq. in.

15. In the square $s^2 = 1386$ [§ 190]. ∴ $s = \sqrt{1386} = 37.23-$.
Whence, $p = 4\,s = 4 \times 37.23 = 148.92$.
∴ the perimeter of the square = 148.92 rd.
In the circle $A = \frac{22}{7} \times r^2$ [§ 245, 4] $= 1386$.
Whence, $r^2 = \frac{7}{22} \times 1386 = 441$. And $r = \sqrt{441} = 21$.
$c = \frac{22}{7} \times d$ [§ 245, 2] $= \frac{22}{7} \times 42 = 132$.
∴ the circumference = 132 rd.
Whence, 148.92 rd. − 132 rd., or 16.92 rd. = the difference.

16. The amount of land over which the cow can graze equals the area of the inscribed circle, because,
$s^2 = 1600$; whence, $s = 40 = d$, or $r = 20$.
$A = \frac{22}{7} \times r^2$ [§ 245, 4] $= \frac{22}{7} \times \overline{20}^2 = 1257\frac{1}{7}$.
∴ $1257\frac{1}{7}$ sq. yd. = the land over which she can graze.

17. In the first circle $c = \frac{22}{7} \times d$ [§ 245, 2] $= \frac{22}{7} \times 2 \times 6 = \frac{264}{7}$.
In the second circle $c = \frac{22}{7} \times 2 \times 3 = \frac{132}{7}$.
In the required circle $c = \frac{264}{7} + \frac{132}{7} = \frac{396}{7} = \frac{22}{7} \times d$.
∴ $d = \frac{7}{22}$ of $\frac{396}{7}$, or 18. Whence, $r = 9$.
∴ the radius of the required circle = 9 ft.

18. In the first circle $A = \frac{22}{7} \times r^2$ [§ 245, 4] $= \frac{22}{7} \times 4^2$.
In the second circle $A = \frac{22}{7} \times 3^2$.
In the required circle $A = \frac{22}{7}(4^2 + 3^2) = \frac{22}{7} \times 25 = \frac{22}{7} \times r^2$.
∴ $r^2 = \frac{7}{22}$ of $\frac{22}{7} \times 25 = 25$. Whence $r = 5$; and $d = 10$.
∴ the diameter of the required circle is 10 ft.

19. 1 mi. = 5280 ft. ∴ $c = 5280 = \frac{22}{7} \times d$ [§ 245, 2].
Whence, $d = \frac{7}{22}$ of $5280 = 1680$.

20. $c = 4 \times 1\frac{4}{7} = \frac{44}{7} = \frac{22}{7} \times d$ [§ 245, 2].
Whence, $d = \frac{7}{22}$ of $\frac{44}{7} = 2$; and $r = 1$.
∴ the radius = 1 ft.
$A = \frac{22}{7} \times r^2$ [§ 245,4] $= \frac{22}{7} \times 1^2 = 3\frac{1}{7}$.
∴ the area of the circle = $3\frac{1}{7}$ sq. ft.

21. $p = 8s = 32$. Whence, $s = 4$.
$a = 1.2071 \times 4 = 4.8284$.
$A = \frac{1}{2} a \times p$ [§ 399] $= 2.4142 \times 32 = 77.2544$.
∴ the area = 77.2544 sq. ft.

Exercise 134, page 305.

In addition to the notation adopted in Exercise 133, which applies here to the base only, add the following: —
h = the number of units in the altitude, or height.
L = the number of square units in the lateral area.
S = the number of square units in the entire surface.
v = the number of cubic units in the volume.

3. $p = 4 \times 4 = 16$, and $h = 3$.
$L = h \times p = 3 \times 16 = 48$ [§ 407, 1].
∴ the lateral area = 48 sq. ft.

4. 18 in. = $1\frac{1}{2}$ ft. Now, $A = 12$, and $h = 1\frac{1}{2}$.
$v = h \times A = 1\frac{1}{2} \times 12 = 18$ [§ 407, 2].
∴ the volume = 18 cu. ft.

5. $s = 5$, $p = 4s = 20$, and $h = 4$.
$A = s^2 = 25$. $L = h \times p = 4 \times 20 = 80$ [§ 407, 1].
$S = L + 2A = 80 + 50 = 130$.
$\therefore$ the entire surface $= 130$ sq. ft.

6. $p = 6s = 6 \times 3 = 18$, and $h = 10$.
$L = h \times p = 10 \times 18 = 180$ [§ 407, 1].
$\therefore$ the lateral area $= 180$ sq. ft.

7. $A = 48$, and $v = 288$, to find h.
$v = 288 = h \times A = 48h$ [§ 407, 2].
Whence, $h = \frac{1}{48}$ of $288 = 6$.
$\therefore$ the altitude $= 6$ ft.

8. $v = 150$, and $h = 6$, to find s.
$v = 150 = h \times A = 6A$ [§ 407, 2].
Whence, $A = s^2 = \frac{1}{6}$ of $150 = 25$, and $s = \sqrt{25} = 5$.
$\therefore$ one side of the base $= 5$ ft.

9. $r = 1$, and $h = 14$, to find v. [1 ft. = 12 in.]
$A = \frac{22}{7} \times r^2 = \frac{22}{7} \times 1 = \frac{22}{7}$ [§ 245, 4].
$v = h \times A = 14 \times \frac{22}{7} = 44$ [§ 247, 2].
$\therefore$ the volume of the pillar $= 44$ cu. ft.
Whence, $44 \times 165\frac{3}{4}$ lb. $= 7293$ lb. $=$ the weight of the pillar.

10. 10 T. $= 10 \times 2000$ lb. $= 20000$ lb.
$= [20000 : 60]$ bu. $= \frac{1000}{3}$ bu. $= \frac{1000}{3} \times \frac{5}{4}$ cu. ft. $= \frac{1250}{3}$ cu. ft.
Now, $v = \frac{1250}{3}$, $A = 6 \times 10 = 60$, to find h.
$v = \frac{1250}{3} = h \times A = 60A$ [§ 407, 2].
Whence, $h = \frac{1}{60}$ of $\frac{1250}{3} = 6\frac{17}{18}$.
$\therefore$ the depth of the bin $= 6\frac{17}{18}$ ft.

11. $\overline{AC}^2 = \overline{AB}^2 + \overline{BD}^2 + \overline{CD}^2$ [Sug.].
$\therefore$ $\overline{AC}^2 = \overline{12}^2 + \overline{14}^2 + \overline{16}^2 = 144 + 196 + 256 = 596$.
Whence, $AC = \sqrt{596} = 24.41$.
$\therefore$ the distance from the upper corner to the opposite lower corner $= 24.41$ ft.

12. Suppose Fig., Ex. 11, to represent a cube in which $s = 6$.
$\overline{AC}^2 = \overline{AB}^2 + \overline{BD}^2 + \overline{CD}^2 = s^2 + s^2 + s^2 = 3s^2 = 3 \times 36 = 108$ [Sug., Ex. 11].
Whence, $AC = \sqrt{108} = 10.39$.
$\therefore$ the diagonal $= 10.39$ ft.

13. Let Fig., Ex. 11, represent a cube in which $AC = 8$.
Now, $\overline{AC}^2 = 64 = 3\,s^2$ [see solution 12].
Whence, $6\,s^2 = S = 2 \times 64 = 128$.
$\therefore$ the entire surface $= 128$ sq. ft.

14. $A = \frac{22}{7} \times r^2 = \frac{22}{7} \times (\frac{5}{2})^2 = \frac{275}{4}$ [§ 245, 4].
$v = h \times A = 60 \times \frac{275}{14} = \frac{8250}{7}$ [§ 247, 2].
$\therefore$ the volume $= \frac{8250}{7}$ cu. ft. $= [\frac{8250}{7} : 27]$ cu. yd. $= 43\frac{41}{63}$ cu. yd.

Exercise 135, Page 307.

In addition to notation used in Exercise 134, use $l =$ the number of units in the slant height.

3. $c = 26$, and $l = 15$, to find L.
$L = \frac{1}{2}\,l \times c = \frac{1}{2}$ of $15 \times 26 = 195$ [§ 410, 2].
$\therefore$ the lateral area $= 195$ sq. in.

4. $A = 42$, $h = 18$, to find v.
$v = \frac{1}{3}\,h \times A = \frac{1}{3}$ of $18 \times 42 = 252$ [§ 410, 3].
$\therefore$ the volume $= 252$ cu. in.

5. In rt. $\triangle\ PRS$, $SR = \frac{1}{2}\,s = \frac{1}{2}$ of $6 = 3$.
$\overline{PS}^2 = \overline{PR}^2 + \overline{SR}^2 = h^2 + \overline{SR}^2 = 8^2 + 3^2 = 73$.
Whence, $PS = l = \sqrt{73} = 8.54$.
$\therefore$ the slant height $= 8.54$ ft.

6. $p = 4\,s = 4 \times 18 = 72$. $SR = \frac{1}{2}$ of $18 = 9$.
$\overline{PS}^2 = l^2 = \overline{PR}^2 + \overline{SR}^2 = 12^2 + 9^2 = 225$.
Whence, $l = \sqrt{225} = 15$.
$L = \frac{1}{2}\,l \times p = \frac{1}{2}$ of $15 \times 72 = 540$ [§ 410, 1].
$\therefore$ the lateral area $= 540$ sq. in.

7. $p = 6\,s = 6 \times 6 = 36$, and $l = 20$.
$L = \frac{1}{2}\,l \times p = 10 \times 36 = 360$ [§ 410, 1].
$\therefore$ the lateral area $= 360$ sq. in. $= [360 : 144]$ sq. ft. $= 2\frac{1}{2}$ sq. ft.

8. $\overline{PC}^2 = \overline{PA}^2 - \overline{AC}^2$.
$\therefore\ h^2 = l^2 - r^2 = \overline{10}^2 - 6^2 = 64$. Whence, $h = \sqrt{64} = 8$.
$\therefore$ the altitude $= 8$ in.

9. $h^2 = l^2 - r^2 = \overline{15}^2 - \overline{12}^2 = 81$. Whence, $h = \sqrt{81} = 9$.
$A = \frac{22}{7} \times r^2 = \frac{22}{7} \times \overline{12}^2 = \frac{3168}{7}$ [§ 245, 4].

$v = \frac{1}{3} h \times A = \frac{1}{3}$ of $9 \times \frac{3168}{7} = 1357\frac{5}{7}$ [§ 410, 3].
∴ the volume $= 1357\frac{5}{7}$ cu. in.

10. $r^2 = l^2 - h^2 = \overline{25}^2 - \overline{20}^2 = 225$. Whence, $r = \sqrt{225} = 15$.
$c = \frac{22}{7} \times d = \frac{22}{7} \times 30 = \frac{660}{7}$ [§ 245, 2].
$L = \frac{1}{2} l \times c = \frac{1}{2}$ of $25 \times \frac{660}{7} = \frac{8250}{7}$ [§ 410, 2].
$A = \frac{22}{7} \times r^2 = \frac{22}{7} \times 225 = \frac{4950}{7}$ [§ 245, 4].
$S = L + A = \frac{8250}{7} + \frac{4950}{7} = 1885\frac{5}{7}$.
∴ the entire surface $= 1885\frac{5}{7}$ sq. in.

11. $L = 192 = \frac{1}{2} l \times p = \frac{1}{2} l \times 24 = 12\,l$ [§ 410, 1].
Whence, $l = \frac{1}{12}$ of $192 = 16$.
∴ the slant height $= 16$ in.

12. $A = \frac{22}{7} \times r^2 = \frac{22}{7} \times 4^2 = \frac{352}{7}$ [§ 245, 4].
$v = 352 = \frac{1}{3} h \times A = \frac{1}{3} h \times \frac{352}{7} = \frac{352}{21} h$ [§ 410, 3].
Whence, $h = \frac{21}{352} \times 352 = 21$.
∴ the altitude $= 21$ in.

13. $v = 300 = \frac{1}{3} h \times A = \frac{1}{3}$ of $9 \times A = 3 \times A$ [§ 410, 3].
Whence, $A = s^2 = \frac{1}{3}$ of $300 = 100$; and $s = \sqrt{100} = 10$.
∴ the side $= 10$ in.

14. $L = 47\frac{1}{7} = \frac{330}{7} = \frac{1}{2} l \times c = \frac{1}{2}$ of $5 \times c = \frac{5}{2} c$ [§ 410, 2].
Whence, $c = \frac{2}{5}$ of $\frac{330}{7} = \frac{132}{7} = \frac{22}{7} \times d$ [§ 245, 2].
And $d = 2\,r = \frac{7}{22}$ of $\frac{132}{7} = 6$. Whence, $r = 3$.
∴ the radius of the base $= 3$ ft.

15. $h = 3$, and $d = 3$, to find $\frac{2}{3}$ of v.
$v = \frac{1}{3} h \times A = \frac{1}{3}$ of $3 \times A = A$ [§ 410, 3].
$A = v = \frac{22}{7} \times r^2 = \frac{22}{7} \times (\frac{3}{2})^2 = \frac{99}{14}$ [§ 245, 4].
Whence, $\frac{2}{3} v = \frac{2}{3}$ of $\frac{99}{14} = 4\frac{5}{7}$.
∴ $4\frac{5}{7}$ = the number of cubic inches in $\frac{2}{3}$ of the wineglass.

16. 18 ft. = 6 yd.; 12 ft. = 4 yd.; whence, $d = 6$, and $h = 4$.
$c = \frac{22}{7} \times d = \frac{22}{7} \times 6 = \frac{132}{7}$. $l^2 = h^2 + r^2 = 4^2 + 3^2 = 25$; whence, $l = 5$.
$L = \frac{1}{2} l \times c = \frac{1}{2}$ of $5 \times \frac{132}{7} = 47\frac{1}{7}$.

17. $l = 5$, and $d = 6$, to find v.
$A = \frac{22}{7} \times r^2 = \frac{22}{7} \times 3^2 = \frac{198}{7}$ [§ 245, 4].
$h^2 = l^2 - r^2 = 5^2 - 3^2 = 16$ [see Fig., Ex. 8].
Whence, $h = 4$.
$v = \frac{1}{3} h \times A = \frac{1}{3}$ of $4 \times \frac{198}{7} = 37\frac{5}{7}$ [§ 410, 3].
∴ the volume $= 37\frac{5}{7}$ ccm.

18. $A = 36$, and $l = 5$, to find v.
$s = \sqrt{36} = 6$. $h^2 = l^2 - (\frac{1}{2} s)^2 = 25 - 9 = 16$ [see Fig., Ex. 5].
Whence, $h = \sqrt{16} = 4$.
$v = \frac{1}{3} h \times A = \frac{1}{3}$ of $4 \times 36 = 48$ [§ 410, 3].
$\therefore$ the volume $= 48^{\text{ccm}}$.

Exercise 136, Page 310.

Adopt the notation used in Exercises 133 to 135 inclusive.

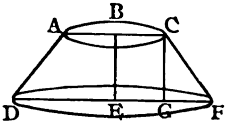
3. $L = \frac{1}{2}$ of $8 \times (6 \times 10 + 6 \times 5) = 4 \times 90 = 360$ [§ 413].
$\therefore$ the lateral area $= 360$ sq. in.

4. $v = \frac{1}{3}$ of $5 \times [\frac{22}{7} \times \overline{16}^2 + \frac{22}{7} \times \overline{10}^2 + \sqrt{\frac{22}{7} \times \overline{16}^2 \times \frac{22}{7} \times \overline{10}^2}]$ [§ 414]
$= \frac{5}{3} \times \frac{22}{7}[256 + 100 + 160] = \frac{110}{21} \times 516 = 2702\frac{6}{7}$.
$\therefore$ the volume $= 2702\frac{6}{7}$ cu. in.

5. $L = \frac{1}{2}$ of $6 \times (4 \times 5 + 4 \times 3) = 3 \times 32 = 96$ [§ 413].
Lower base, $A = s^2 = 3^2 = 9$.
Whence, $L + A = 96 + 9 = 105$.
$\therefore$ the number of square feet of zinc required $= 105$.

6. $v = \frac{1}{3}$ of $9 \times [\frac{22}{7} \times 2^2 + \frac{22}{7} \times 3^2 + \sqrt{\frac{22}{7} \times 2^2 \times \frac{22}{7} \times 3^2}]$ [§ 414]
$= 3 \times \frac{22}{7}[4 + 9 + 6] = \frac{66}{7} \times 19 = 179\frac{1}{7}$.
$\therefore$ the number of cubic inches of water $= 179\frac{1}{7}$.

7. $\frac{1}{4}$ of 282, or $\frac{141}{2}$ = the number of cubic inches in 1 qt. of milk [§ 204].
$v = \frac{1}{3}$ of $8 \times [\frac{22}{7} \times 5^2 + \frac{22}{7} \times 7^2 + \sqrt{\frac{22}{7} \times 5^2 \times \frac{22}{7} \times 7^2}]$ [§ 414]
$= \frac{8}{3} \times \frac{22}{7} \times [25 + 49 + 35] = \frac{176}{21} \times 109 = \frac{19184}{21}$.
$\therefore$ the volume $= \frac{19184}{21}$ cu. in.
Now, $\frac{19184}{21} : \frac{141}{2}$, or $\frac{2}{141}$ of $\frac{19184}{21}$, or $12.96-$ = the number of quarts.



8. In the lower base,
$c = 37\frac{5}{7} = \frac{264}{7} = \frac{22}{7} \times DF$ [§ 245, 2].
Whence, $DF = \frac{7}{22}$ of $\frac{264}{7} = 12$; and $EF = 6$.
In the upper base,
$c = 18\frac{6}{7} = \frac{132}{7} = \frac{22}{7} \times AC$.
Whence, $AC = \frac{7}{22} \times \frac{132}{7} = 6$; and $BC = 3$.
$GF = EF - EG = EF - BC = 6 - 3 = 3$.

Now, $\overline{CG}^2 = \overline{CF}^2 - \overline{GF}^2 = 5^2 - 3^2 = 16$. Whence, $CG = 4$.

$v = \frac{1}{3}$ of $4 \times [\frac{22}{7} \times 6^2 + \frac{22}{7} \times 3^2 + \sqrt{\frac{22}{7} \times 6^2 \times \frac{22}{7} \times 3^2}]$ [§ 414]

$= \frac{4}{3} \times \frac{22}{7} \times [36 + 9 + 18] = \frac{88}{21} \times 63 = 264$.

∴ 264 = the number of cubic feet in the vat.

Whence, 264 × 1728 = the number of cubic inches in the vat.

And $\frac{264 \times 1728}{231}$ = the number of gallons in the vat [§ 203].

∴ $1974\frac{6}{7}$, or 1975– = the number of gallons in the vat.

Exercise 137, Page 311.

Adopt the notation used in Exercises 133 to 136 inclusive.

3. $s = \frac{88}{7} \times r^2 = \frac{88}{7} \times (\frac{5}{4})^2 = 19\frac{9}{14}$ [§ 416, 1].

∴ the area of the sphere = $19\frac{9}{14}$ sq. ft.

4. $v = \frac{88}{21} \times r^3 = \frac{88}{21} \times (\frac{7}{2})^3 = \frac{88}{21} \times \frac{7}{2} \times \frac{7}{2} \times \frac{7}{2} = \frac{539}{3} = 179\frac{2}{3}$ [§ 416, 2].

∴ the volume = $179\frac{2}{3}$ cu. ft.

5. $S = \frac{88}{7} \times r^2 = 154$ [§ 416, 1].

Whence, $r^2 = \frac{7}{88} \times 154 = \frac{49}{4}$; and $r = \frac{7}{2} = 3\frac{1}{2}$.

∴ the radius = $3\frac{1}{2}$ ft.

6. $v = \frac{88}{21} \times r^3 = 1437\frac{1}{3} = \frac{4312}{3}$ [§ 416, 2].

Whence, $r^3 = \frac{21}{88} \times \frac{4312}{3} = 343$; and $r = 7$.

$d = 2r = 14$.

∴ the diameter = 14 in.

7. $c = \frac{22}{7} \times d = \frac{22}{7} \times 28 = 88$ [§ 245, 2].

∴ the circumference = 88 in.

8. $c = \frac{22}{7} \times d = 66$ [§ 245, 2].

∴ $d = \frac{7}{22} \times 66 = 21$.

∴ the diameter = 21 in.

9. $c = \frac{22}{7} \times d = 132$ [§ 245, 2].

$d = \frac{7}{22} \times 132 = 42$. Whence, $r = 21$.

$S = \frac{88}{7} \times r^2 = \frac{88}{7} \times \overline{21}^2 = 5544$ [§ 416, 1].

∴ the area = 5544 sq. in.

$v = \frac{88}{21} \times r^3 = \frac{88}{21} \times \overline{21}^3 = 38808$ [§ 416, 2].

∴ the volume = 38808 cu. in.

10. $s = \frac{88}{7} \times r^2 = 9856$ [§ 416, 1].

Whence, $r^2 = \frac{7}{88} \times 9856 = 784$; and $r = \sqrt{784} = 28$.

$c = \frac{22}{7} \times d = \frac{22}{7} \times 2 \times 28 = 176$ [§ 245, 2].

∴ the circumference = 176 in.

11. $v = \frac{88}{21} \times r^3 = 113\frac{1}{7} = \frac{792}{7}$ [§ 416, 2].
Whence, $r^3 = \frac{21}{88} \times \frac{792}{7} = 27$; and $r = \sqrt[3]{27} = 3$.
$c = \frac{22}{7} \times d = \frac{22}{7} \times 2 \times 3 = 18\frac{6}{7}$ [§ 245, 2].
$\therefore$ the circumference $= 18\frac{6}{7}$ ft.

12. $s = \frac{88}{7} \times r^2 = 7546$ [§ 416, 1].
Whence, $r^2 = \frac{7}{88} \times 7546 = \frac{2401}{4}$; and $r = \sqrt{\frac{2401}{4}} = \frac{49}{2}$.
$v = \frac{88}{21} \times r^3 = \frac{88}{21} \times (\frac{49}{2})^3 = 61625\frac{2}{3}$.
$\therefore$ the volume $= 61625\frac{2}{3}$ cu. in.

13. $v = \frac{88}{21} \times r^3 = 179\frac{2}{3} = \frac{539}{3}$ [§ 416, 2].
Whence, $r^3 = \frac{21}{88} \times \frac{539}{3} = \frac{343}{8}$; and $r = \sqrt[3]{\frac{343}{8}} = \frac{7}{2}$.
$S = \frac{88}{7} \times r^2 = \frac{88}{7} \times (\frac{7}{2})^2 = 154$ [§ 416, 1].
$\therefore$ the area $= 154$ sq. ft.

14. In the small balls $r = \frac{1}{2}$. Let $x =$ the number of inches in the diameter of the required ball.
Now, $\frac{88}{21} \times x^3 = 8 \times \frac{88}{21} \times (\frac{1}{2})^3$ [§ 416, 2].
$\therefore x^3 = 8 \times \frac{1}{8} = 1$. Whence, $x = 1$ and, $2x = d = 2$.
$\therefore$ the diameter $= 2$ in.

15. In the small balls $r = 2$. Let $x =$ the number of inches in the radius of the required ball.
Now, $\frac{88}{7} \times x^2 = 16 \times \frac{88}{7} \times r^2 = 16 \times \frac{88}{7} \times 4$ [§ 416, 1].
Whence, $x^2 = 64$. Or, $x = 8$ and $d = 16$.
$\therefore$ the diameter required $= 16$ in.

16. The diameter of the sphere $=$ the diameter and the altitude of the cylinder $= 6$ in.
$s = \frac{88}{7} \times r^2 = \frac{88}{7} \times 3^2 = 113\frac{1}{7}$.
$\therefore$ the area of the sphere $= 113\frac{1}{7}$ sq. in.

17. The diameter of the sphere $=$ the diameter of the cylinder $=$ the altitude of the cylinder.
$s = \frac{88}{7} \times r^2 = 176$ [§ 416, 1].
Whence, $r^2 = \frac{7}{88}$ of $176 = 14$; or, $r = \sqrt{14} = 3.74166$.
In the cylinder $h = 2 \times 3.74166 = 7.48332$, and $r^2 = 14$.
$v = h \times A = 7.48332 \times \frac{22}{7} \times 14 = 329.27$ [§ 247, 2, and § 245, 4].
$\therefore$ the volume of the cylinder $= 329.27$ cu. ft.

18. In the cylinder $d = 3$, $r = \frac{3}{2}$, and $h = 3$.
$v = h \times A = 3 \times \frac{22}{7} \times (\frac{3}{2})^2 = \frac{297}{14}$ [§ 247, 2].
In the sphere $r = \frac{3}{2}$.

$v = \frac{88}{21} \times r^3 = \frac{88}{21} \times (\frac{3}{2})^3 = \frac{297}{21}$ [§ 416, 2].

$\therefore$ $\frac{297}{14} - \frac{297}{21}$, or $\frac{297}{42}$, or $7\frac{1}{14}$ = the number of cubic inches in the difference.

$\therefore$ the number of cubic inches of water remaining in the mug = $7\frac{1}{14}$.

Exercise 138, Page 314.

1. $x = \frac{3 \times 6}{4} = 4\frac{1}{2}$ [§ 334, Cor. 1].
$\therefore$ the altitude required = $4\frac{1}{2}$ ft.

2. $x = \frac{\overline{14}^2 \times 38.5}{7^2} = 2^2 \times 38.5 = 154$ [§ 334, Cor. 1].
$\therefore$ the area required = 154 sq. ft.

3. $x = \frac{3^2 \times 169}{5^2} = 60.84$ [§ 334, Cor. 1].
$\therefore$ the lateral area of the first = 60.84 sq. ft.

4. $x = 8^3 \times \frac{11}{21} = 268\frac{4}{21}$ [§ 334, Cor. 1].
$\therefore$ the volume of the first = $268\frac{4}{21}$ cu. ft.

5. $x = \frac{7 \times 66}{22} = 21$ [§ 334, Cor. 1].
$\therefore$ the diameter of the second = 21 ft.

6. $x = \frac{30 \times 3\sqrt{3}}{36} = \frac{5}{2}\sqrt{3}$ [§ 334, Cor. 2].
$\therefore$ the apothem of the first = $\frac{5}{2}\sqrt{3}$ ft.

7. $96 : 216 = x^2 : 6^2$ [§ 423, 3].
Whence, $x^2 = \frac{6^2 \times 96}{216} = 16$ [§ 334, Cor. 2].
And $x = 4$.
$\therefore$ the side of the first square = 4 in.

8. $3\frac{1}{2} : 1\frac{1}{2} = \frac{49}{44} : x$ [§ 423, 1].
Whence, $7 : 3 = 49 : 44x$ [§ 100].
$\therefore$ $44x = \frac{3 \times 49}{7} = 21$; and $x = \frac{21}{44}$ [§ 334, Cor. 1].
$\therefore$ the diameter of the second circle = $\frac{21}{44}$ ft.

9. $77 : 308 = 6^3 : x^3$ [§ 423, 4].
Or, $1 : 4 = 216 : x^3$ [§ 102].
Whence, $x^3 = 864$; and $x = \sqrt[3]{864} = 9.52$.
$\therefore$ the radius of the base of the second = 9.52 ft.

10. $256 : x = 3^2 : 5^2 = 9 : 25$ [§ 423, 3].

Whence, $x = \frac{25 \times 256}{9} = 711\frac{1}{9}$ [§ 334, Cor. 2].

$\therefore$ the entire surface of the second $= 711\frac{1}{9}$ sq. in.

11. $30 : 20 = x : 8$ [§ 418].

Whence, $x = \frac{8 \times 30}{20} = 12$ [§ 334, Cor. 2].

$\therefore$ the width of the first $= 12$ rd.

12. $x : 81 = \overline{15}^3 : \overline{20}^3$ [§ 423, 4].

Whence, $x = \frac{81 \times 15 \times 15 \times 15}{20 \times 20 \times 20} = \frac{2187}{64} = 34\frac{11}{64}$ [§ 334, Cor. 1].

$\therefore$ the first will hold $34\frac{11}{64}$ gal.

13. Let x and $y =$ the numbers of gallons that flow through the respective pipes in the given time.

Now, $x : y = 3^2 : \overline{1\frac{1}{2}}^2$ [§ 423, 5].

Or, $x : y = 9 : \frac{9}{4} = 36 : 9 = 4 : 1$ [§§ 100, 102].

Whence, $x = 4y$ [§ 334].

$\therefore$ 4 times as much water will flow through the first orifice as through the second.

14. $112 : x = 18 : 24$ [§ 423, 1].

Whence, $x = \frac{24 \times 112}{18} = 149\frac{1}{3}$ [§ 334, Cor. 2].

$\therefore$ the number of panels required $= 149\frac{1}{3}$.

15. $x : 18 = 2^2 : \overline{1\frac{1}{2}}^2 = 16 : 9$ [§ 100].

Whence, $x = \frac{18 \times 16}{9} = 32$ [§ 334, 1].

$\therefore$ the time required $= 32$ hr.

16. (1) Comparing the diameters:

$1 : 27 = \overline{18\frac{1}{2}}^3 : x^3$ [§ 423, 4].

Whence, $x^3 = 27(18\frac{1}{2})^3$; and $x = 3 \times 18\frac{1}{2} = 55\frac{1}{2}$.

Comparing the depths:

$1 : 27 = 8^3 : x^3$ [§ 423, 4].

Whence, $x^3 = 27 \times 8^3$; and $x = 3 \times 8 = 24$.

$\therefore$ the dimensions of the second vessel are:

Circumference $= 55\frac{1}{2}$ in., and depth $= 24$ in.

17. $452\frac{5}{7} : 16 \times 452\frac{5}{7} = 6^2 : x^2$ [§ 423, 3].
Or, $1 : 16 = 36 : x^2$ [§ 102].
Whence, $x^2 = 16 \times 36$; and $x = 4 \times 6 = 24$.
∴ the diameter of the second ball = 24 in.

18. $128 : 1152 = 8^2 : x^2$ [§ 423, 3].
Or, $1 : 9 = 64 : x^2$ [§ 102].
Whence, $x^2 = 9 \times 64$; and $x = 3 \times 8 = 24$.
∴ the diagonal of the second cube = 24 ft.

Exercise 139, Page 316.

1. 40 A. = 40 × 160 sq. rd. = 6400 sq. rd.
$\sqrt{6400} = 80$ = the number of rods in each side of the tract.
∴ 4 × 80 = 320 = the number of rods around the tract.
There are 6 dividing fences, each 80 rd. long [3 running each way].
∴ 320 + 6 × 80 = 800 = the number of rods of fence required in all.

2. $FB = \frac{1}{2}$ of $AB = 25$ rd.; and $BC = 40$ rd.
$\overline{FC}^2 = \overline{FB}^2 + \overline{BC}^2 = \overline{25}^2 + \overline{40}^2 = 2225$.
Whence, $FC = \sqrt{2225} = 47.17$ = the number of rods in the fence.
$\frac{1}{2}$ of 25 × 40 = 500 = the number of square rods in $\triangle FBC$ [§ 382].
∴ $500 : 160 = 3\frac{1}{8}$ = the number of acres in $\triangle FBC$.

3. $\frac{1}{2}$ of 12 × 18 = 108 = the number of square chains in $\triangle ADC$ [§ 382].
$\frac{1}{2}$ of 6 × 18 = 54 = the number of square chains in $\triangle ABC$.
∴ 108 sq. ch. + 54 sq. ch. = 162 sq. ch. = 16.2 A. = the area of the field.
Or, 16.2 = the number of acres in the field.

4. $\overline{Bm}^2 = \overline{AB}^2 - \overline{Am}^2 = \overline{15}^2 - 9^2 = 144$. Whence, $Bm = 12$.
$Dn = AD - An = 38 - 32 = 6$.
$\overline{Cn}^2 = \overline{CD}^2 - \overline{Dn}^2 = 10^2 - 6^2 = 64$. Whence, $Cn = 8$.
$Dr = AD - Ar = 38 - 26 = 12$.
$\overline{Er}^2 = \overline{DE}^2 - \overline{Dr}^2 = \overline{20}^2 - \overline{12}^2 = 256$. Whence, $Er = 16$.
$\overline{Fs}^2 = \overline{AF}^2 - \overline{As}^2 = \overline{25}^2 - \overline{20}^2 = 225$. Whence, $Fs = 15$.
$mn = Am - An = 32 - 9 = 23$.
$sr = Ar - As = 26 - 20 = 6$.
$\frac{1}{2}$ of $Am \times Bm = \frac{1}{2}$ of $9 \times 12 = 54$ = the number of square rods in ABC [§ 382].
$\frac{1}{2}$ of $mn \times [Bm + Cn] = \frac{1}{2}$ of $23 \times [12 + 8] = 230$ = the number of square rods in $mBCn$ [§ 395].

$\frac{1}{2}$ of $Dn \times Cn = \frac{1}{2}$ of $6 \times 8 = 24$ = the number of square rods in CnD.

$\frac{1}{2}$ of $Dr \times Er = \frac{1}{2}$ of $12 \times 16 = 96$ = the number of square rods in EDr.

$\frac{1}{2}$ of $sr \times [Er + Fs] = \frac{1}{2}$ of $6 \times [16 + 15] = 93$ = the number of square rods in $FsrE$.

$\frac{1}{2}$ of $As \times Fs = \frac{1}{2}$ of $20 \times 15 = 150$ = the number of square rods in FAS.

$\therefore$ $54 + 230 + 24 + 96 + 93 + 150 = 647$ = the number of square rods in the entire field.

Whence, 647 sq. rd. $= 4\frac{7}{160}$ A. $=$ 4 A. 7 sq. rd. = the area of the field.

5. $2 \times 50 \times 24 = 2400$ = the number of feet of boards required for the front and back of the barn.

$2 \times 36 \times 24 = 1728$ = the number of feet of boards required for the ends of the barn to the gables.

$2 \times \frac{1}{2}$ of $36 \times 16 = 576$ = the number of feet of boards required for the two gables.

$\therefore$ $2400 + 1728 + 576 = 4704$ = the number of feet of boards required in all.

6. The length of the rail = the hypotenuse of a right triangle whose base $= 15 \times 9$ in., or 135 in., and whose altitude $= 15 \times 12$ in., or 180 in.

$\overline{\text{Hypotenuse}}^2 = \overline{\text{base}}^2 + \overline{\text{altitude}}^2 = \overline{135}^2 + \overline{180}^2 = 50625.$

Whence, hypotenuse $= \sqrt{50625} = 225$.

$\therefore$ the length of the rail = 225 in. = $18\frac{3}{4}$ ft.

7. $28 \times 22 = 616$ = the number of square feet in the floor.

$24 \times 18 = 432$ = the number of square feet in the rug.

$\therefore$ $616 - 432 = 184$ = the number of square feet uncovered.

8. Let x = the number of inches in the length cut off.

$\therefore$ $18x$ = the number of square inches in the part cut off.

Whence, $18x = 144$; and $x = 8$.

$\therefore$ the length of the piece cut off = 8 in.

9. $60 \times 120 = 7200$ = the number of square feet in the lot.

$42 \times 48 = 2016$ = the number of square feet under the house.

Whence, $7200 - 2016 = 5184$ = the number of square feet in the yard.

$\therefore$ the area of the yard = 5184 sq. yd.

10. 36 in. + 12 in. = 48 in. = the length of the framed glass.

20 in. + 12 in. = 32 in. = the width of the framed glass.

$\therefore$ $32 \times 48 = 1536$ = the number of square inches in the framed glass.

$20 \times 36 = 720$ = the number of square inches in the unframed glass.

$\therefore$ $1536 - 720 = 816$ = the number of square inches in the frame.

11. If the lengths of the leaves are cut from the length of the sheet, and the width of the leaves from the width of the sheet, there will be 6×5 leaves $= 30$ leaves.

If the lengths of the leaves are cut from the width of the sheet, and the width of the leaves from the length of the sheets, there will be 4×8 leaves, or 32 leaves.

$\therefore$ the greatest number of leaves is 32.

12. $24 : 4 = 6 =$ the number of tops in one row.

$30 : 4 = 7 =$ the number of rows in the sheet.

$\therefore$ $7 \times 6 = 42 =$ the number of tops in all.

13. 45×5280 ft. $=$ the rate of the locomotive per hour.

$\therefore$ $[45 \times 5280] : 16 =$ the number of revolutions the locomotive made per hour.

Whence, $[45 \times 5280 : 16] \div 60 = 247\frac{1}{2} =$ the number of revolutions the locomotive made per minute.

14. In one hour the point of the hand moves over the circumference of the dial.

$\therefore$ $\frac{22}{7} \times d = \frac{22}{7} \times 21\frac{1}{3} = 67\frac{1}{21} =$ the number of feet the point of the hand moves over in 1 hr. [§ 245, 2].

15. $\frac{22}{7} \times r^2 = \frac{22}{7} \times \overline{11}^2 = 380\frac{2}{7} =$ the number of square feet in the dial.

$\therefore$ the area of the dial $= 380\frac{2}{7}$ sq. ft.

16. The pole, the radius of the ring, and the line form a right triangle whose altitude $= 40$ ft. and whose hypotenuse $= 50$ ft.

$r^2 = \overline{50}^2 - \overline{40}^2 = 2500 - 1600 = 900.$

$\frac{22}{7} \times r^2 = \frac{22}{7} \times 900 = 2828\frac{4}{7} =$ the number of square feet in the area of the circus ring [§ 245, 4].

$\therefore$ the area of the ring $= 2828\frac{4}{7}$ sq. ft.

17. 4 in. $=$ the radius of the unframed dial.

5 in. $=$ the radius of the framed dial.

$\frac{22}{7} \times 5^2 =$ the number of square inches in the framed dial.

$\frac{22}{7} \times 4^2 =$ the number of square inches in the unframed dial.

Whence, $\frac{22}{7} \times [5^2 - 4^2] = 28\frac{2}{7} =$ the number of square inches in the frame.

18. $1^{\text{Hm}} = 10^{\text{Dm}}.$

$10 \times 10 = 100 =$ the number of square dekameters $=$ the number of ares in the land.

19. $\frac{22}{7} \times \overline{ON}^2 = \frac{22}{7} \times 8^2$ = the number of square yards in the larger circle.

$\frac{22}{7} \times \overline{OM}^2 = \frac{22}{7} \times 6^2$ = the number of square yards in the smaller circle.

$\therefore\ \frac{22}{7} \times (8^2 - 6^2) = 88$ = the number of square yards in the walk.

And $88 \times 9 = 792$ = the number of square feet in the walk.

20. $\overline{16}^2 = 256$ = the number of square feet in the bordered carpet.

$\frac{15}{64}$ of $256 = 60$ = the number of square feet in the border.

$\therefore\ 256 - 60 = 196$ = the number of square feet in the unbordered carpet.

Whence, $\sqrt{196} = 14$ = the number of feet in the length of the unbordered carpet.

$\therefore\ \frac{1}{2}$ of (16 ft. − 14 ft.) = 1 ft. = the width of the border.

21. $8^2 = 64$ = the number of square inches in the square.

$\frac{22}{7} \times r^2 = \frac{22}{7} \times 4^2 = 50\frac{2}{7}$ = the number of square inches in the circle.

$\therefore\ 64 - 50\frac{2}{7} = 13\frac{5}{7}$ = the number of square inches wasted.

22. $\frac{1}{2}$ mi. = $\frac{1}{2}$ of 5280 ft. = 2640 ft.

2640 : 40 = 66 = the number of 40 ft. spaces in 2640 ft.

∴ 67 trees may be planted on each side of the street.

Whence, 2 × 67 = 134 = the number of trees on both sides of the street.

23. 66 ft. = the diagonal of the square.

$\therefore\ \overline{66}^2 = 4356 = s^2 + s^2 = 2\,s^2$.

Whence, $s^2 = 2178$ = the number of square feet in the square.

$\frac{22}{7} \times r^2 = \frac{22}{7} \times \overline{33}^2 = 3422\frac{4}{7}$ = the number of square feet in the circle [§ 245, 4].

$\therefore\ 3422\frac{4}{7} - 2178 = 1244\frac{4}{7}$ = the number of square feet sodded.

24. The altitude, h, one side, s, and $\frac{1}{2}$ the base, $\frac{1}{2}\,s$, form a right triangle.

Now, $s^2 - (\frac{1}{2}\,s)^2 = \frac{3}{4}\,s^2 = h^2 = 5^2 = 25$.

Whence, $s^2 = \frac{4}{3}$ of $25 = 33.3333\cdots$, and $s = \sqrt{33.3333} = 5.77$.

$\therefore\ \frac{1}{2}\,h \times s = \frac{1}{2}$ of $5 \times 5.77 = 14.43$ = the number of square feet in the area [§ 382].

25. $\frac{22}{7} \times r^2 \times h = \frac{22}{7} \times 4^2 \times 40 = 2011.43$ = the number of cubic feet in the well [§ 247, 2].

Whence, 2011.43 : 27 = $74\frac{1}{2}$ nearly = the number of cubic yards in the well.

26. The top and bottom are each 4 ft. by $3\frac{1}{2}$ ft.

The two side pieces are each 4 ft. by 3 ft. – 2 in. [= $2\frac{5}{6}$ ft.].

The two end pieces are each $3\frac{1}{2}$ ft. – 2 in. by 3 ft. – 2 in.; or $3\frac{1}{3}$ ft. by $2\frac{5}{6}$ ft.

$\therefore\ 2 \times 3\frac{1}{2} \times 4 = 28$ = the number of square feet in the top and the bottom.

$2 \times 2\frac{5}{6} \times 4 = 22\frac{2}{3}$ = the number of square feet in the sides.

$2 \times 2\frac{5}{6} \times 3\frac{1}{3} = 18\frac{8}{9}$ = the number of square feet in the ends.

$\therefore\ 28 + 22\frac{6}{9} + 18\frac{8}{9} = 69\frac{5}{9}$ = the number of square feet in all.

27. The inner dimensions of the box are: length $3\frac{5}{6}$, or $\frac{23}{6}$ ft.; width $3\frac{1}{3}$, or $\frac{10}{3}$ ft.; and depth $2\frac{5}{6}$, or $\frac{17}{6}$ ft.

$\therefore\ \frac{23}{6} \times \frac{10}{3} \times \frac{17}{6}$ = the number of cubic feet in the box.

Whence, $\frac{4}{5}$ of $\frac{23}{6} \times \frac{10}{3} \times \frac{17}{6} = 28\frac{26}{27}$ = the number of bushels of wheat the box will hold [§ 205, N. 2].

28. $\frac{1}{2}$ of $9 \times [4\frac{1}{2} + 3\frac{1}{2}] = 36$ = the number of square feet in one end of the crib = the base of the prism [§ 395] = A.

$\therefore\ v = h \times A = 36 \times 36$ = the number of cubic feet in the crib [§ 407, 2].

Whence, $\frac{16}{25}$ of $36 \times 36 = 829.44$ = the number of heaped bushels the crib will hold.

$\therefore\ \frac{1}{2}$ of 829.44 bu., or $414\frac{18}{25}$ bu. = the amount of corn.

29. $4 \times 3 \times 1\frac{1}{2} = 18$ = the number of cubic feet in the block.

$\therefore\ 18 \times 2.78 \times 62.5$ lb. = $3127\frac{1}{2}$ lb. = the weight of the block.

30. $14^{\text{m}} = 140^{\text{dm}}$.

$140 \times \frac{22}{7} \times r^2 = 140 \times \frac{22}{7} \times (\frac{5}{2})^2 = 2750$ = the number of cubic decimeters in the tube [§ 247, 2].

1^{ccm} of water weighs 1^{g}; whence, 1^{cdm} weighs 1^{Kg} [§ 219].

$\therefore\ 2750^{\text{cdm}}$ weigh 2750^{Kg}.

31. Let x and y = the number of cubic miles in the earth and the moon.

Now, $x : y = 1^3 : (\frac{3}{11})^3$ [§ 423, 4].

$\therefore\ \frac{27}{1331} \times x = y$. Whence, $x = \frac{1331}{27}$ of $y = 49\frac{8}{27}\,y$.

$\therefore$ the earth is $49\frac{8}{27}$ times as large as the moon.

32. $\overline{20}^3 = 8000$ = the number of cubic inches in the unplated cube.

$8000 + 1261 = 9261$ = the number of cubic inches in the plated cube.

$\therefore\ \sqrt[3]{9261} = 21$ = the number of inches in the edge of the plated cube.

Whence, 21 in. – 20 in. = 1 in. = *twice* the thickness of the plating.

$\therefore$ the thickness of the plating is $\frac{1}{2}$ an inch.

33. $\frac{1}{3}$ of $6 \times [4^2 + 9^2 + \sqrt{4^2 \times 9^2}]$ = the number of cubic feet in the hopper [§ 414].

$\therefore\ 2 \times [16 + 81 + 36] = 266$ = the number of cubic feet in the hopper.

Whence, $\frac{16}{25} \times 266 = 170\frac{6}{25}$ = the number of bushels of ashes the hopper will hold.

34. $847 \times 63 \times 231$ = the number of cubic inches in the tank.

$\therefore\ \sqrt[3]{847 \times 63 \times 231} = \sqrt[3]{7^3 \times 11^3 \times 3^3} = 231$ = the number of inches in the depth of the tank.

$\therefore$ 231 in. = 19 ft. 3 in. = the depth of the tank.

35. 1 sq. yd. = 9 sq. ft., and 1 in. = $\frac{1}{12}$ of a foot.

$\therefore\ \frac{1}{12}$ of $9 = \frac{3}{4}$ = the part of a cubic foot of water that fell on 1 sq. yd.

Whence, $\frac{3}{4}$ of 62.5 lb. = $46\frac{7}{8}$ lb. = the weight of the water.

36. $\sqrt[3]{1728} = 12$ = the number of inches in each edge of the cube.

$\therefore\ 6 \times \overline{12}^2 = 864$ = the number of square inches in the entire surface.

Whence, 864 × 10 ct. = $86.40 = the cost required.

37. 4 in. = $\frac{1}{3}$ of a foot.

$v = h \times A = h \times (\frac{1}{3})^2 = \frac{1}{9}h = 1$ [§ 407, 2].

$\therefore\ h = 1 + \frac{1}{9} = 9.$

$\therefore$ the length of the bar = 9 ft.

38. 1^{cbm} of water weighs 1^{MT} [§§ 219 and 226].

$\therefore\ 8^{\text{MT}} = 8^{\text{cbm}}$ = the capacity of the tank.

Whence, $\sqrt[3]{8} = 2$ = the number of meters in each edge.

$\therefore\ 5 \times 2^2 = 20$ = the number of square meters in the 5 faces lined.

Whence, 20 × 15 ct. = $3.00 = the cost of lining the cistern.

39. $8 \times \frac{22}{7} \times r^2 = 8 \times \frac{22}{7} \times 2^2 = \frac{22}{7} \times 32$ = the number of cubic feet in the entire cylinder [§ 247, 2].

2 ft. − 2 in. = $1\frac{5}{6}$ ft. = $\frac{11}{6}$ ft. = the radius of the hollow part.

$8 \times \frac{22}{7} \times (\frac{11}{6})^2 = \frac{22}{7} \times \frac{242}{9}$ = the number of cubic feet in the hollow part.

$\therefore\ \frac{22}{7} \times [32 - \frac{242}{9}] = \frac{22}{7} \times \frac{46}{9}$ = the number of cubic feet of cast iron.

Whence, $\frac{22}{7} \times \frac{46}{9} \times 550$ lb. = 8835 lb. = the weight of the cast iron.

40. d = 8 in. = $\frac{2}{9}$ of a yard; whence, $r = \frac{1}{9}$ of a yard.

$100 \times \frac{88}{7} \times r^2 = \frac{8800}{7} \times (\frac{1}{9})^2 = 15.52$ = the number of square yards in the surfaces of the balls [§ 416, 1].

41. $\frac{88}{21} \times r^3 = \frac{88}{21} \times 3^3 = \frac{88}{21} \times 27$ = the number of cubic inches in the uncovered ball.

3 in. + $\frac{1}{2}$ in. = $3\frac{1}{2}$ in. = the radius of the covered ball.

∴ $\frac{88}{21} \times (\frac{7}{2})^3 = \frac{88}{21} \times \frac{343}{8}$ = the number of cubic inches in the covered ball.

Whence, $\frac{88}{21} \times [\frac{343}{8} - 27] = \frac{1397}{21}$ = the number of cubic inches of metal used.

∴ $\frac{1397}{21} \times 8$ ct. = \$5.32 = the value of the copper used.

Exercise 140, Page 321.

1. $\frac{\cancel{6} \times 9 \times \cancel{24}}{\cancel{144}} = 9$ = the number of cubic feet in the stick.

2. $\frac{22 \times \cancel{24} \times 35}{\cancel{144}} = \frac{770}{6} = 128\frac{1}{3}$ = the number of cubic feet in the stick.

3. $\frac{\overset{6}{\frac{4}{9}} \text{ of } [\frac{1}{2}(34 + 20)]^2 \times 36}{144} = \frac{\overline{27}^2 \times \cancel{16}}{\underset{9}{\cancel{144}}} = \frac{\overset{3}{\cancel{27}} \times 27}{\cancel{9}} = 81$ = the number of cubic feet in the log [§ 426, R.].

4. $\frac{\frac{1}{2} \text{ of } [\frac{1}{2}(34 + 20)]^2 \times 36}{144} = \frac{27^2 \times \cancel{18}}{\underset{8}{\cancel{144}}} = 91\frac{1}{8}$ = the number of cubic feet in the log.

5. $\frac{(16 - 4)^2}{\underset{8}{\cancel{16}}} \times \overset{9}{\cancel{18}} = \frac{\overset{18}{\cancel{144}} \times 9}{\cancel{8}} = 162$ = the number of feet of boards in the log [§ 427, R.].

6. $\frac{(12 - 4)^2}{\underset{4}{\cancel{16}}} \times \overset{5}{\cancel{20}} = \frac{\overset{16}{\cancel{64}} \times 5}{\cancel{4}} = 80$ = the number of feet of boards in the log.

7. $\frac{\frac{4}{9} \text{ of } [\frac{1}{2}(60 + 45)]^2 \times 40}{144} = \frac{\cancel{4} \times \overline{105}^2 \times \overset{10}{\cancel{40}}}{9 \times \cancel{4} \times \underset{36}{\cancel{144}}} = 340\frac{5}{18}$ = the number of cubic feet in the log [§ 426, R.].

8. $\frac{(25 - 4)^2}{16} \times 35 = \frac{441 \times 35}{16} = 965$ = the number of feet required.

9. $\frac{(20 - 4)^2}{\underset{4}{\cancel{16}}} \times \overset{5}{\cancel{20}} = \frac{\overset{64}{\cancel{256}} \times 5}{\cancel{4}} = 320$ = the number of feet required.

10. $\frac{(24 - 4)^2}{16} \times 36 \text{ ft.} = \frac{\overset{100}{\cancel{400}}}{\underset{4}{\cancel{16}}} \times 36 \text{ ft.} = 900 \text{ ft.}$ = the amount of boards.

11. $\dfrac{(36-4)^2}{16} \times 30\text{ ft.} = 1920\text{ ft.}$

12. $\dfrac{(40-4)^2}{\cancel{16}} \times \cancel{16}\text{ ft.} = 1296\text{ ft.}$

13. $\dfrac{(44-4)^2}{16} \times 18\text{ ft.} = 1800\text{ ft.}$

14. $\dfrac{(60-4)^2}{16} \times 32\text{ ft.} = 6272\text{ ft.}$

15. $\dfrac{(32-4)^2}{16} \times 28\text{ ft.} = 1372\text{ ft.}$

16. $\dfrac{(22-4)^2}{\underset{4}{\cancel{16}}} \times \overset{3}{\cancel{12}}\text{ ft.} = 243\text{ ft.}$

17. $\dfrac{(12-4)^2}{\underset{2}{\cancel{16}}} \times \overset{3}{\cancel{24}}\text{ ft.} = 96\text{ ft.}$

18. $\dfrac{(24-4)^2}{16} \times 24\text{ ft.} = 600\text{ ft.}$

19. $\dfrac{(12-4)^2}{\underset{4}{\cancel{16}}} \times \overset{3}{\cancel{12}}\text{ ft.} = 48\text{ ft.}$

20. $\dfrac{(24-4)^2}{16} \times 12\text{ ft.} = 300\text{ ft.}$

Miscellaneous Problems, Page 323.

1. 40,254; forty thousand two hundred fifty-four.

2. Six billion twenty-four million six hundred thousand one; 6,024,600,001.

3. Any number of eight figures may be used.

4. See page 9, § 22.

6. 27,050,046; 75,060,000,490; 1209; 1849; 494.

$$\begin{array}{rr}
 & 6,358,789\\
 & 208,835\\
 & 86,686\\
 & 39,759\\
 & 50,373\\
 & 5,698\\
 & \underline{1,057}\\
7,208,244\ - & 6,751,197 = 457,047.
\end{array}$$

8.
$$\begin{array}{lr}
\$1,100,000 - \$1,000,000 = & \$100,000\\
\$1,000,000 - \$900,009 = & \underline{\$99,991}\\
\text{The latter is nearer by} & \$9
\end{array}$$

9. 36 words = 10 words + 26 words.

25¢ = the cost of sending the first 10 words.

52¢ = the cost of sending the additional 26 words.

∴ 77¢ = the entire cost.

10. 7845
2478
62760 sixty-two thousand seven hundred sixty.
54915 five hundred forty-nine thousand one hundred fifty.
31380 three million one hundred thirty-eight thousand.
15690 fifteen million six hundred ninety thousand.
19439910

11. $\frac{\$498-(8\times\$32+6\times\$35)}{8}$, or $\$32\div 8$, or $4 = the required gain.

12. B's number + 106 = A's.
B's number = B's.
∴ 2 × B's number + 106 = A's + B's, or 2028.
2 × B's = 2028 − 106, or 1922.
B's number = 961, and A's = 961 + 106, or 1067.

13. 24 × $32 − 14 × $6, or $684 = the required amount of cash.

14. 993529)$139381522($140 = the amount required.
993529
4002862
3974116
287462

15. 11|000000)1430|000000 lb.
130 lb. = the required amount.

16. 1502321)20281334 bu.(13 bu.
1502321
5258124
4506963

Since 2 × 751161 is greater than 1502321, the yield is more than 13½ bu. per acre; hence, estimated to the nearest bushel, the yield is 14 bu.

17. 6 × 75 bu. + 42 bu., or 492 bu. = the required amount.

18. $\frac{40}{100}$ of $2400, or $960 = the amount B will receive.

19. 24; see page 69, § 99.

20. 100 × $0.05, or $5 = the cost at $0.05 per bushel.
$\frac{100\times 60}{100}\times\$0.08\frac{3}{4}$, or $5.25 = the cost at $0.08¾ per 100 lb.
∴ $5.25 − $5, or $0.25 = the amount by which the former is cheaper.

21. The smaller + 62 = the larger.

∴ 2 × the smaller + 62 = both, or 984.

∴ 2 × the smaller = 984 − 62, or 922; whence, 461 = the smaller, and 461 + 62, or 523 = the larger.

22. 2 × the smaller = the larger.

∴ 3 × the smaller = the sum, or 1002.

∴ $\frac{1}{3}$ of 1002, or 334 = the smaller, and 2 × 334, or 668 = the larger.

23. \$40 + \$4, or \$44 = the cost of a cow and a calf.

\$396 = the total cost.

∴ \$396 : \$44, or 9 = the number of each bought.

24. $\{(87 + 13) \times 5 + 10\} \times \{275 \div \overline{15 - 10} \times 4\}$

$= (100 \times 5 + 10) \times (275 \div 5 \times 4)$

$= 500 + 10 \times 55 \times 4 = 510 \times 55 \times 4$, or 112200.

25. 1×24; 2×12; 3×8; 4×6; 2×2×6; 3×2×4; 2×2×2×3. The last set are the prime factors of 24.

26. (1) 23, 2, 1 are prime. See p. 57, § 68.

(2) 18, 15, 49, 81, 121, 93, 69 are composite. See p. 57, § 69.

(3) and (4) 18, 2 are even, and 15, 23, 1, 49, 81, 121, 93, 69 are odd. See p. 58, § 76.

27. 2 will divide 124, 478, 2340. See p. 58, § 78.

3 will divide 111, 819, 2340. See p. 59, § 79.

4 will divide 124, 2340. See p. 59, § 80.

5 will divide 215, 2340. See p. 58, § 78.

9 will divide 819, 2340. See p. 59, § 79.

28.

$$\begin{array}{r|r}
2 & 96 - 144 \\ \hline
2 & 48 - 72 \\ \hline
2 & 24 - 36 \\ \hline
2 & 12 - 18 \\ \hline
3 & 6 - 9 \\ \hline
 & 2 - 3
\end{array}$$

The common prime factors of 96 and 144 are 2, 2, 2, 2, and 3 [§ 82].

∴ The common divisors of 96 and 144 are 2, 3, 2×2, 2×3, 2×2×2, 2×2×3, 2×2×2×3, 2×2×2×2, and 2×2×2×2×3; or, 2, 3, 4, 6, 8, 12, 24, 16, and 48.

29.

$$\begin{array}{l}
1032)1505(1 \\
\quad \underline{1032} \\
\quad\; 473)1032(2 \\
\qquad\quad\; \underline{946} \\
\qquad\quad\;\; 86)473(5 \\
\qquad\qquad\;\; \underline{430} \\
\qquad\qquad\;\; 43)86(2 \\
\qquad\qquad\qquad\; \underline{86}
\end{array}$$

The last divisor obtained by the successive division of 1032 and 1505 is 43.

∴ 43 is g. c. d. of 1032 and 1505 [§ 108].

30. The sum of 1, 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97 = 1061.

31. $\frac{\cancel{7}\times\cancel{11}\times 2\times 3\times 2\times\cancel{5}}{\cancel{7}\times\cancel{11}\times\cancel{5}}=12$, the required quotient.

32. The first will leave every multiple of 7 da. after Jan. 18.

The second will leave every multiple of 10 da. after Jan. 18.

They will leave together every common multiple of 7 da. and 10 da. after Jan. 18.

They will leave together the first time after Jan. 18 in the least common multiple of 7 da. and 10 da., or 70 da., or on March 29.

33. The l. c. m. of $20 and $50, or $100 = the required sum.

34. The l. c. m. of 3, 4, and 7, or 84 = the required number.

35. The l. c. m. of 12 and 14, or 84 = the number that will make an exact number of groups of either kind.

∴ 85 = the number of workmen, which will make 7 groups of 12 men each and leave one for overseer.

36. $200-(\frac{2}{3}+22\frac{1}{4}+148\frac{1}{12}+6\frac{1}{6})$, or $22\frac{5}{6}$ = the required number.

37. $\frac{\frac{3}{4}\text{ of }\frac{4}{5}\div 1\frac{2}{3}+1-16\frac{2}{3}\div 33\frac{1}{3}\times 2\frac{1}{2}}{100\div 14\frac{2}{7}\times\frac{6}{7}-4\frac{2}{3}+1\frac{1}{4}\div 2}=\frac{\frac{9}{25}+1-1\frac{1}{4}}{6-4\frac{2}{3}+\frac{5}{8}}=\frac{11}{100}\div\frac{47}{24}$, or $\frac{66}{1175}$.

38. 2640 ft. ÷ 168, or $15\frac{5}{7}$ ft. = the circumference.

∴ $15\frac{5}{7}$ ft. ÷ $\frac{22}{7}$, or 5 ft. = the diameter.

39. A can do $\frac{1}{4}$ of the work in 1 da., and B and A can do all of it in a day. Therefore B can do $\frac{3}{4}$ of the work in a day, and to do all of it will require him $\frac{4}{3}$ da., or $1\frac{1}{3}$ da.

40. A can do $\frac{1}{2}$ of the work in a day, and B can do $\frac{1}{5}$ of it in a day. Both can do $\frac{1}{2}+\frac{1}{5}$, or $\frac{7}{10}$, of it in a day. Then A can do the remaining $\frac{3}{10}$ of it in $\frac{3}{10}$ of 2 da., or $\frac{3}{5}$ da.

41. A can cut $\frac{1}{3}$ of a cord in $\frac{1}{4}$ of a day, or $\frac{4}{3}$ of a cord per day.

B can cut $\frac{1}{2}$ of a cord in $\frac{1}{3}$ of a day, or $\frac{3}{2}$ of a cord per day.

Both can cut $\frac{4}{3}$ of a cord plus $\frac{3}{2}$ of a cord, or $\frac{17}{6}$ of a cord per day.

To cut 1 cord will require them $\frac{6}{17}$ of a day.

42. .02002 ÷ .002 = 20.02 ÷ 2, or 10.01, read ten and one hundredth.

43. $\frac{.02\div .002}{.002\div .02}\div\frac{.02\div 200}{20\div .02}\times\frac{.16\frac{2}{3}\div 8\frac{1}{3}}{100\div 66\frac{2}{3}}$

$=\frac{10}{.1}\div\frac{.0001}{1000}\times\frac{.02}{\frac{3}{2}}=100\div .0000001\times .01\frac{1}{3}$

$=1000000000\times .01\frac{1}{3}$, or $13333333\frac{1}{3}$.

44. $100 \div \frac{10}{11}$ of $62\frac{1}{2}$, or $100 \div \frac{625}{11}$, or $1\frac{19}{25}$ = the required number.

45. $100 \times \$3.50$, or $\$350$ = the cost.
$10000 \div 4 \times \$0.25$, or $\$625$ = the selling price.
$\therefore$ $\$625 - \$350$, or $\$275$ = the gain.

46. 1320 ft. = the distance the trains runs in 45 sec.
$\therefore$ $\frac{4}{3}$ of 1320 ft., or 1760 ft. = the distance the train runs per minute.
$\therefore$ $\frac{60 \times 1760}{5280}$, or 20 = the number of miles the train runs per hour.

47. 450 yd. − 125 yd., or 325 yd. = the distance the second walks, while the first walks 450 yd.
$\therefore$ 450 yd. : 325 yd., or $1\frac{5}{13}$ = the required number.

48. The minute hand moves over 60 min. spaces per hour, and the hour hand 5 min. spaces per hour. Therefore the minute hand moves 12 times as fast as the hour hand.

49. The minute hand moves over 60 spaces, while the hour hand moves over 5 spaces.
$\therefore$ The minute hand gains 55 spaces in going 60 spaces.
$\therefore$ The minute hand gains $13\frac{3}{4}$ spaces in going 15 spaces.
At 7 o'clock the minute hand had to gain 35 spaces.
At 7.15 o'clock the minute hand had gained $13\frac{3}{4}$ spaces.
$\therefore$ $35 - 13\frac{3}{4}$, or $21\frac{1}{4}$ = the required number.

50. The minute hand gains 55 spaces in going 60 spaces.
$\therefore$ The minute hand gains $\frac{11}{12}$ of a space in going 1 space.
And the minute hand gains $15 \times \frac{11}{12}$ of a space, or $13\frac{3}{4}$ spaces in 15 min.

51. The minute hand gains 55 spaces in going 60 spaces.
$\therefore$ The minute hand gains 1 space in going $\frac{12}{11}$ spaces, or in $1\frac{1}{11}$ min.
And the minute hand gains 5 spaces in going $5\frac{5}{11}$ spaces, or in $5\frac{5}{11}$ min.

52. At 8 o'clock the minute hand points to 12 and the hour hand to 8; hence the minute hand is 40 minute spaces behind the hour hand.
The minute hand must go $\frac{12}{11}$ spaces to gain 1 space.
$\therefore$ The minute hand must go $40 \times \frac{12}{11}$ spaces, or $43\frac{7}{11}$ spaces to gain 40 spaces, or to overtake the hour hand.

53. At 5 o'clock the minute hand is 25 minute spaces behind the hour hand, and hence must gain 25 spaces to overtake it. The minute hand must go $25 \times \frac{12}{11}$ spaces, or $27\frac{3}{11}$ spaces. The hands are together at $27\frac{3}{11}$ min. after 5 o'clock.

54. When both have walked 5 rd., the first has walked 3 rd., and the second 2 rd.

∴ The first walks $\frac{3}{5}$ of the total distance, and the second $\frac{2}{5}$ of it.

320 rd. = the distance both walk.

∴ $\frac{3}{5}$ of 320 rd., or 192 rd., and $\frac{2}{5}$ of 320 rd., or 128 rd. = the required distances.

55. The first gains 2 steps, or 5 ft., in walking 5 steps.

The first must gain $\frac{1}{2}$ mi., or 2640 ft., or 528 × 5 ft.

∴ 528 × 5, or 2640 = the required number of steps.

56. 20 × $3, or $60 = the value of the wine; also of the mixture.

$2.50 = the value of 1 gal. of the mixture.

∴ $60 : $2.50, or 24 = the number of gallons of mixture.

∴ 24 − 20, or 4 = the number of gallons of water added.

57. 3 pwt. 8 gr., or 80 gr. = the amount of pure gold.

$\frac{18}{24}$, or $\frac{3}{4}$ of the mixture = the amount of pure gold.

∴ $\frac{3}{4}$ of the mixture = 80 gr.

∴ $\frac{1}{4}$ of the mixture, or the alloy = $\frac{1}{3}$ of 80 gr., or $26\frac{2}{3}$ gr., or 1 pwt. $2\frac{2}{3}$ gr.

58. $\dfrac{305\cancel{0}\times \overset{3043}{\cancel{6}\cancel{0}\cancel{8}\cancel{6}}}{\underset{264}{\cancel{5}\cancel{2}\cancel{8}\cancel{0}}}$, or $3515\frac{155}{264}$ = the required number of miles [§ 183, (3)].

59. 2000 lb. : 4.5 lb., or 20000 ÷ 45, or $444\frac{4}{9}$ = the number of bricks in a ton.

∴ 444 = the number that the man should load.

60. 2 bu. 2 pk., or 10 pk., of lump lime will make 20 pk. of slaked lime.

Since 1 pk. of potash is used with 10 pk. of slaked lime, 2 pk. of potash must be used with 20 pk. of slaked lime.

61. 12 × 1 × $\frac{1}{6}$, or 2 = the number of cubic feet in the plank.

∴ 2 × 59.375 lb., or 118.75 lb. = the weight of the plank.

62. 1 lb. (troy) = 5760 gr.

371.25 gr. = the amount of pure silver in a silver dollar.

∴ 5760 gr. : 371.25 gr., or

371.25) 5760.00 (15 = the number of dollars.
37125
204750
185625
191.25 = the number of grains remaining.

63. $\dfrac{\cancel{60} \times \overset{15}{\cancel{60}} \times \overset{545}{\cancel{1090}}}{\underset{\underset{\underset{11}{\cancel{22}}}{\cancel{88}}}{\cancel{5280}}}$, or $743\frac{2}{11}$ = the number of miles required.

64. 3¼ × $2, or $6.50 = the cost.
3 lb. 4 oz. (avoir.) = 3¼ × 7000 gr., or 22750 gr.
1 ʒ 2 ℈ = 100 gr.
∴ 22750 ÷ 100, or 227.5 = the number of packages.
227.5 × $0.05, or $11.375 = the selling price.
And $11.375 − $6.50, or $4.875 = the gain.

65. $\dfrac{\overset{88}{\cancel{5280}} \times \overset{2}{\cancel{40}}}{\cancel{60} \times \cancel{20}}$, or 176 = the required number.

66. 30 × $0.10, or $3 = the difference between the selling price of 30 bu. of wheat and 30 bu. of corn.
∴ $38 − $3, or $35 = the selling price of 50 bu. of corn.
∴ $35 ÷ 50, or $0.70 = the selling price of 1 bu. of corn.
And $0.70 + $0.10, or $0.80 = the selling price of 1 bu. of wheat.

67. 240 lb. = .240 of 1000 lb. = .12 T.
∴ 2 T. 240 lb. = 2.12 T.
∴ 2.12 × $14.50, or $30.74 = the cost.

68. The column must march 1 mi. 880 yd., or 1½ mi.
∴ 1½ mi. : 2½ mi., or 1½ ÷ 2½, or ⅗ = the part of an hour required.
⅗ hr. = ⅗ of 60 min., or 36 min.

69. $\dfrac{8 \times 16 \times 4 \times 2}{12}$, or 85⅓ = the number of board feet.
85⅓ bd. ft. = .085⅓ M. bd. ft.
.085⅓ × $24, or $2.048, or $2.05 = the cost.

70.
$$\begin{array}{r} 2142 \\ 2163 \\ \underline{2205} \\ 6\cancel{0})\overline{651\cancel{0}} \\ \overline{108\frac{1}{2}} \end{array}$$
108½ = the number of bushels.
108½ × $0.80, or $86.80 = the sum received.

71. 1 long ton = 2240 lb. = 22.4 × 100 lb.
22.4 × $0.28, or $6.27 = the required sum.

72. 360°, or the circumference of a circle = 16 × 22° 30′.

16 × 6 in., or 8 ft. = the required length.

73. 2 min. 15 sec. = $\frac{3}{80}$ hr.

$\frac{3}{80}$ of 20 mi., or $\frac{3}{4}$ mi. = the distance the train ran in crossing the bridge.

Then, $\frac{3}{4}$ mi., or 1320 yd. − 176 yd., or 1144 yd. = the length of the bridge.

74. $\dfrac{2\cancel{0}\times\cancel{14}\times 1\cancel{0}\times\overset{113.38}{\cancel{566.9}}}{\underset{\cancel{5}}{\cancel{7000}}}$, or 226.76 = the number of pounds required.

75. $\frac{3}{4}$ of 77.16 gr., or 57.87 gr. = the amount of copper in a 5¢ piece.

100 × 57.87 gr., or 5787 gr. = the amount of copper in $5 worth of 5¢ pieces.

1 oz. (troy) = 480 gr.

5787 ÷ 480, or $12\frac{9}{160}$ = the number of ounces required.

76. $12\frac{1}{2}$%, or $\frac{1}{8}$ of $0.40, or $0.05 = the gain per yard.

∴ $0.45 = the selling price per yard.

10%, or $\frac{1}{10}$ of the marked price = the selling price.

∴ $\frac{9}{10}$ of m. p. = s. p., or $0.45.

∴ $\frac{10}{9}$ of $0.45, or $0.50 = m. p.

77. 120%, or $\frac{6}{5}$ of cost = s. p., or $15.

∴ $\frac{5}{6}$ of $15, or $$12\frac{1}{2}$ = cost.

75%, or $\frac{3}{4}$ of m. p. = s. p., or $15.

∴ $\frac{4}{3}$ of $15, or $20 = m. p.

∴ $20 − $$12\frac{1}{2}$, or $$7\frac{1}{2}$ = the amount m. p. was above cost.

$$7\frac{1}{2} = \frac{3}{5}$ of $$12\frac{1}{2}$.

∴ $\frac{3}{5}$ of 100%, or 60% = the required per cent.

78. $133\frac{1}{3}$% of cost = the retail price.

12% of $133\frac{1}{3}$% of cost, or 16% of cost = the discount at wholesale.

∴ $133\frac{1}{3}$% of cost − 16% of cost, or $117\frac{1}{3}$% of cost = s. p. at wholesale.

∴ $17\frac{1}{3}$% = the required rate.

79. $12\frac{1}{2}$¢ = the selling price of 25 envelopes.

10¢ = the cost of 25 envelopes.

∴ $2\frac{1}{2}$¢ = the gain on 25 envelopes.

∴ $\dfrac{2\frac{1}{2}}{10}$, or $\frac{1}{4}$ of cost = gain.

Then, $\frac{1}{4}$ of 100%, or 25% = the rate of gain.

80. 80%, or $\frac{4}{5}$ of cost = the selling price, or $6.
∴ $\frac{5}{4}$ of $6, or $7.50 = the cost.
20%, or $\frac{1}{5}$ of $7.50, or $1.50 = the advance in marking.
∴ $7.50 + $1.50, or $9 = the marked price.

81. 120%, or $\frac{6}{5}$ of wholesale price = retail price.
110% of cost = wholesale price.
∴ $\frac{6}{5}$ of 110% of cost, or 132% of cost = retail price.
∴ 32% of cost = gain at retail.

82. $\frac{4}{5}$ s. p. = $\frac{2}{3}$ cost.
$\frac{1}{5}$ s. p. = $\frac{1}{6}$ cost.
∴ s. p. = $\frac{5}{6}$ cost, or $\frac{5}{6}$ of 100% of cost, or $83\frac{1}{3}$% of cost.
∴ $16\frac{2}{3}$% of cost = loss.

83. $850.00 ÷ 2500, or $0.34 = the amount paid on $1.
That is, 34 = the number of cents paid on $1.

84. $260 : $1.30, or 200 = the number of bushels bought.
$260 + $13, or $273 = the selling price of those sold.
140% of $1.30, or $1.82 = the selling price of 1 bu.
∴ $273 : $1.82, or 150 = the number of bushels sold.
And 200 − 150, or 50 = the number of bushels B kept.

85. 20¢ = the cost of 1 doz. of first kind.
60¢ = the cost of 2 doz. of second kind.
∴ 80¢ = the cost of 3 doz. of the mixture.
120¢ = the s. p. of 3 doz. of the mixture.
∴ 40¢ = the gain on 3 doz. of the mixture.
∴ $\frac{1}{2}$ of cost = gain, and $\frac{1}{2}$ of 100%, or 50% = the rate of gain.

86. $16\frac{2}{3}$%, or $\frac{1}{6}$ of $0.90, or $0.15 = the discount to retailers.
∴ $0.75 = the selling price to retailers.
$0.90 = the retailer's selling price.
∴ $0.15 = the retailer's gain, or $\frac{15}{75}$, or $\frac{1}{5}$ of cost = gain.
∴ $\frac{1}{5}$ of 100%, or 20% = the rate.

87. 8 × $0.50, or $4.00 = the cost of 8 lb.
8 × $0.40, or $3.20 = the cost of 8 lb.
4 × $0.60, or $2.40 = the cost of 4 lb.
∴ $9.60 = the cost of 20 lb.
And $\frac{1}{20}$ of $9.60, or $0.48 = the cost of 1 lb.
25%, or $\frac{1}{4}$ of $0.48, or $0.12 = the gain per pound.
∴ $0.48 + $0.12, or $0.60 = the selling price per pound.

88. 125%, or $\frac{5}{4}$ of \$4, or \$5 = the m. p.
10%, or .1 of \$5, or \$0.50 = the discount.
∴ \$4.50 = s. p.
∴ \$4.50 − \$4, or \$0.50 = the gain.
\$0.50 = $\frac{1}{8}$ of \$4.
∴ $\frac{1}{8}$ of cost = the gain.
∴ $\frac{1}{8}$ of 100%, or 12½% = the rate.

89. 50 × \$0.20, or \$10 = the cost.
60%, or .6 of \$10, or \$6 = the gain.
∴ \$16 = the net selling price.
\$16 + \$4, or \$20 = the gross selling price.
∴ 50 bu., or 200 pk. sold for \$20.
∴ \$20.00 ÷ 200, or \$0.10 = the s. p. per peck.

90. 36 = 18 × 2; 12 = 4 × 3.
18 × 5¢, or 90¢ = the sum received for half of them.
4 × 5¢, or 20¢ = the sum received for 1 doz. of them.
24 × 1¢, or 24¢ = the sum received for 24 of them.
∴ \$1.34 = the sum received for all of them.
\$1.34 − \$0.90, or \$0.44 = the gain.
$\frac{44}{90}$ of 100%, or 48$\frac{8}{9}$% = the rate of gain.

91. 12 × \$0.10, or \$1.20 = the s. p. of 1 doz.
\$1.00 = the cost of 1 doz.
∴ \$0.20 = the gain on 1 doz.
∴ \$0.20 = the gain on \$1, or 20% = the rate.

92. 133⅓%, or $\frac{4}{3}$ of the cost of first = s. p., or \$40.
∴ $\frac{3}{4}$ of \$40, or \$30 = cost of first.
88$\frac{8}{9}$%, or $\frac{8}{9}$ of the cost of second = s. p., or \$40.
∴ $\frac{9}{8}$ of \$40, or \$45 = cost of second.
\$30 + \$45, or \$75 = cost of both.
\$80 − \$75, or \$5 = gain on both.
$\frac{5}{75}$, or $\frac{1}{15}$ of cost = gain.
∴ $\frac{1}{15}$ of 100%, or 6⅔% = the rate.

93. 120% of cost = m. p.
80% of m. p. = s. p.
∴ 80% of 120% of cost, or 96% of cost = s. p.
∴ 4% of cost = loss.

94. 20%, or $\frac{1}{5}$ of sales = commission.
$2421 = commission.
∴ $\frac{1}{5}$ of sales = $2421 ; whence, sales = $12105.
$12105 − $2421, or $9684 = net proceeds.

95. 60 × $18, or $1080 = cost of fertilizer.
2½% of $1080, or $27 = commission.
∴ $1080 + $27, or $1107 = required amount.

96. 1000 × $0.80, or $800 = cost of wheat.
$40 = freight charges.
∴ $840 = total cost less commission.
$856 = total cost.
∴ $856 − $840, or $16 = commission on $800.
$16 = $\frac{1}{50}$ of $800.
∴ $\frac{1}{50}$ of 100%, or 2% = the rate.

97. $250 − $225, or $25 = the commission charged on $250 sales.
∴ $\frac{1}{10}$ of sales = commission; whence, $\frac{1}{10}$ of 100%, or 10% = the rate.

98. 2½% of sales = commission.
∴ 97½% of sales = net proceeds.
$292.50 = net proceeds.
∴ 97.5% of sales = $292.50.
1% of sales = $292.50 ÷ 97.5, or $3.
100% of sales = 100 × $3, or $300.
∴ $300 − $292.50, or $7.50 = commission charged.

99. $435.10 + $6.50, or $441.60 = sales less commission.
96% of sales = sales less commission.
∴ 96% of sales = $441.60.
1% of sales = $441.60 ÷ 96, or $4.60.
100% of sales = 100 × $4.60, or $460.
∴ $460 − $441.60, or $18.40 = commission charged.

100. $\frac{250}{2000}$, or $\frac{1}{8}$ of sales = commission.
∴ $\frac{1}{8}$ of $1684, or $210.50 = commission for April.

101. 4½% of $120, or $5.40 = the dividend on $100 par.
Since dividends are reckoned on par, 5⅖% = the rate of dividend, because $5.40 is 5⅖% of $100.

102. $\frac{1}{40}$ of $1895, or $47.375 = cost of 1 share.
¼% of $50, or $0.125 = brokerage on 1 share.
∴ $47.375 − $0.125, or $47.25 = market value of 1 share.

103. ¼% of $50, or $⅛ = brokerage per share on sale and purchase.
∴ $58⅜ = cost per share, and $60⅛ = net proceeds per share.
Then, $60⅛ − $58⅜, or $1¾ = gain per share on sale.
2 × 2½% of $50, or $2½ = the dividend per share.
∴ $1¾ + $2½, or $4¼ = the total gain per share.
20 × $4¼, or $85 = the total gain.

104. 4 × 2% of $100, or $8 = the income per share per year.
$200 = the total income per year.
∴ $200 : $8, or 25 = the number of shares.
199% of $100, or $199 = market value per share.
⅛% of $100, or $0.125 = brokerage per share.
∴ $199.125 = total cost per share.
∴ 25 × $199.125, or $4978.125 = the sum to be invested.

105. ⅛% of $100, or $0.125 = brokerage on 1 bond, also on 1 share.
110¼% of $100, or $110.25 = the market value of 1 bond.
∴ $110.25 − $0.125, or $110.125 = the proceeds of 1 bond.
60 × $110.125, or $6607.50 = the proceeds of 60 bonds.
$90.625 = cost of 1 share of stock with brokerage.
∴ $6607.50 : $90.625, or 72 = the number of shares, with $82.50 surplus.

106. ¼% of $50, or $0.125 = the brokerage on 1 share of stock.
$34.125 − $0.125, or $34 = the net proceeds of 1 share.
60 × $34, or $2040 = the net proceeds of the stock.
⅛% of $100, or $0.125 = brokerage on 1 bond.
137½% of $100, or $137.50 = the market value of 1 bond.
$137.625 = the total cost of 1 bond.
∴ $2040 : $137.625, or 14 = the number of bonds bought, with $113.25 surplus.

107. 60 × $99.125, or $5947.50 = the cost of the traction stock.
138½% of $100 − ⅛% of $100, or $138.375 = net proceeds of 1 share of D. & H.
∴ $5947.50 : $138.375, or 42 = the number of shares with a deficit of $135.75.
This deficit must be made up by selling another share.
∴ 43 shares must be sold, and $138.375 − $135.75, or $2.625 = the surplus.

```
138.375) 5947.500 (42
         5535.00
         -------
          412.500
          276.750
          -------
          135.75
```

108. 6% of $50, or $3 = income per share.

8% of investment = income.

∴ 8% of investment = $3; whence, investment = $37.50 per share.

109. 6% of $100, or $6 = the income per share.

5% of the investment = income.

∴ 5% of the investment = $6.

∴ The investment per share = $120.

$\frac{1}{8}$% of $100, or $$\frac{1}{8}$ = the brokerage per share.

∴ $120 – $$\frac{1}{8}$, or $$119\frac{7}{8}$ = the market value per share.

110. 6% of $50, or $3 = the income per share.

5% of the investment = income.

∴ 5% of investment = $3.

∴ The investment per share = $60.

$\frac{1}{4}$% of $50, or $$\frac{1}{8}$ = brokerage per share.

∴ $60 – $$\frac{1}{8}$, or $$59\frac{7}{8}$ = the market value per share.

111. $203.75 – $200, or $3.75 = the interest.

$4\frac{1}{2}$% of $200, or $9 = the interest for 1 yr.

∴ $\frac{3\frac{3}{4}}{9}$, or $\frac{5}{12}$ = the part of a year the principal was on interest.

∴ $\frac{5}{12}$ of 360 da., or 150 da. after July 1, or Nov. 28 = date of payment.

112. The time from May 1 to Dec. 1 = 214 da.

$4\frac{1}{2}$% of $200, or $9 = the interest for 1 yr.

$\frac{214}{360}$ of $9, or $5.35 = the common interest.

$\frac{214}{365}$ of $9, or $5.28 = the accurate interest.

∴ $0.07 = the difference.

113. $2\frac{1}{2}$% of the present worth, or cash value = the discount.

∴ 1.025 of the cash value = the credit value, or $4.10.

∴ $4.10 ÷ 1.025, or $4 = the cash value.

114. The bill was paid 3 mo. before due and should be discounted for 3 mo.

1% of the amount paid in 3 mo. = the discount.

∴ 101% of the amount paid in 3 mo. = the debt, or $202.

∴ $202 ÷ 1.01, or $200 = amount paid.

115. $1.03033919 = the amount of $1 for 4 periods at $\frac{3}{4}$% [§ 294].

∴ 100 × $1.03033919, or $103.03 = the amount, correct to the nearest cent.

116. See form on p. 236. The note does not bear interest.

For form of indorsement, see "Indorsement in Blank," p. 239.

The value of the note on the day of issue is $98.98 in states mentioned in note 2, p. 249; in other states, except where "grace" is allowed, the value of the note is $99.

117. See form p. 245. Write *Self* or your own name instead of "Wallace T. Dick," and your own name instead of "Wm. S. Delp." Write the name of the nearest bank instead of "National Bank of Chester County." You should indorse the check before presenting it for payment. See form, p. 239, for indorsement.

118. The share of 3 boys = 6 × the share of a girl.

The share of 3 boys and 3 girls = 9 × the share of a girl.

The share of 3 boys and 3 girls = $3600.

∴ 9 × the share of a girl = $3600.

∴ The share of a girl = $400, and the share of a boy = $800.

119. One of the men worked 6 da., and the other 10 da.

∴ $48 = amount received for 16 days' work.

∴ $3 = amount received for 1 day's work.

Then, 6 × $3, or $18 = amount one should receive.

And 10 × $3, or $30 = amount the other should receive.

120. $\frac{4}{5}$ of $40, or $32 = A's gain had he owned $\frac{4}{5}$ of the stock.

$40 – $10, or $30 = A's gain.

∴ a difference of $12 in the stock made a difference of $2 in the gain, or $12 stock gained $2, or $6 stock gained $1.

∴ $240 = the total stock; $\frac{4}{5}$ of $240 – $12, or $180 = A's stock; and $\frac{1}{5}$ of $240 + $12, or $60 = B's stock.

121. A's gain was $3, B's $4, and C's $5 out of every $12 gained.

∴ A's gain was $\frac{1}{4}$ of the whole gain, B's $\frac{1}{3}$ of it, and C's $\frac{5}{12}$ of it.

∴ A's investment was $\frac{1}{4}$ of the whole investment, B's $\frac{1}{3}$ of it, and C's $\frac{5}{12}$ of it.

$3000 = the total investment.

∴ $\frac{1}{4}$ of $3000, or $750 = A's investment.

$\frac{1}{3}$ of $3000, or $1000 = B's investment.

$\frac{5}{12}$ of $3000, or $1250 = C's investment.

138.375)5
5

108. 6% of $50, or $3 = incom
8% of investment = income.
∴ 8% of investment = $3 ; wh

109. 6% of $100, or $6 = the i
5% of the investment = income
∴ 5% of the investment = $6.
∴ The investment per share =
$\frac{1}{8}\%$ of \$100, or $\$\frac{1}{8}$ = the broke
∴ $\$120 - \$\frac{1}{8}$, or $\$119\frac{7}{8}$ = the

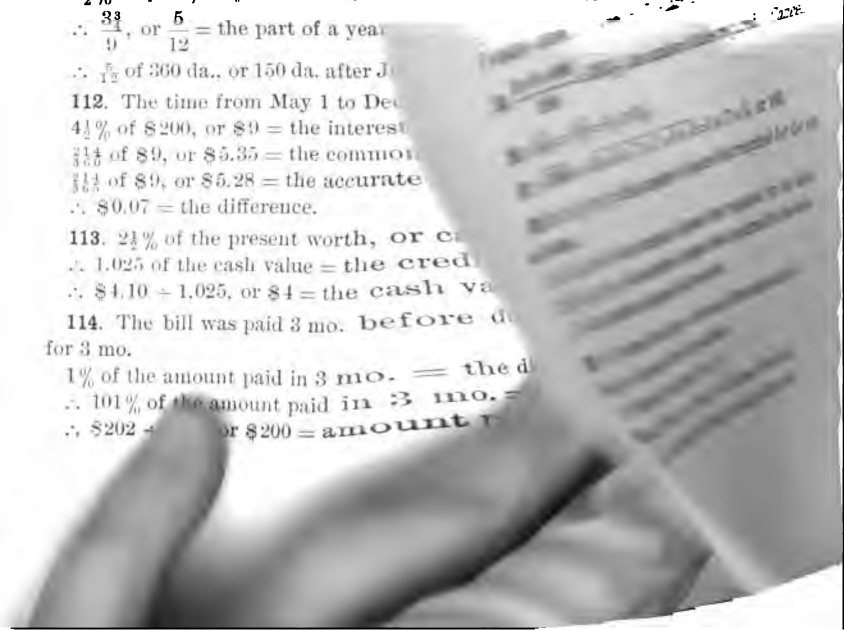
110. 6% of $50, or $3 = the in
5% of the investment = income
∴ 5% of investment = $3.
∴ The investment per share =
$\frac{1}{4}\%$ of \$50, or $\$\frac{1}{8}$ = brokerage
∴ $\$60 - \$\frac{1}{8}$, or $\$59\frac{7}{8}$ = the ma

111. $203.75 – $200, or $3.75
$4\frac{1}{2}\%$ of \$200, or \$9 = the intere
∴ $\frac{3\frac{3}{4}}{9}$, or $\frac{5}{12}$ = the part of a yea
∴ $\frac{5}{12}$ of 360 da., or 150 da. after J

112. The time from May 1 to De
$4\frac{1}{2}\%$ of \$200, or \$9 = the interest
$\frac{214}{360}$ of \$9, or \$5.35 = the commo
$\frac{214}{365}$ of \$9, or \$5.28 = the accurate
∴ $0.07 = the difference.

113. $2\frac{1}{2}\%$ of the present worth, or c
∴ 1.025 of the cash value = the cred
∴ $\$4.10 \div 1.025$, or \$4 = the cash va

114. The bill was paid 3 mo. before d
for 3 mo.
1% of the amount paid in 3 mo. = the d
∴ 101% of the amount paid in 3 mo. =
∴ $202 ÷ or $200 = amount



in the diagonal of a cube, and e the num-
$= e^2 + e^2 + e^2$, or $3e^2$ [see p. 305, Prob. 11,

proportional to the cubes of the radii.

$\times$ [illegible], or 3[illegible].

he number of square units in the area, B and the bases, and h the number of units in the

§ 395].

(30 + 10).

= 320, and $h = 8$.

1 distance.

hypotenuse of a right triangle whose base is

he number of feet in the required length.

1416, or 2150.42, nearly = the number of cubic
, 2].

represented by 1 and 2. The capacities are
cubes of the altitudes.

23 ft. = the length of the floor.
17 ft. = the width of the floor.
ber of square feet in the floor.
ber of square feet in the [illegible]
r of square feet in [illegible]
quired cost.

122.

$$x \text{ ft.} - 40 \text{ ft.} - \$1000.$$
$$1320 \text{ ft.} - 60 \text{ ft.} - \$1800.$$

The width is inversely proportional to the length and directly proportional to the cost.

$$\therefore x : 1320 = \begin{cases} 60 : 40, \\ 1000 : 1800. \end{cases}$$

$$x = \frac{1320 \times 60 \times 1000}{40 \times 1800}, \text{ or } 1100.$$

123.

$$x \text{ ft.} - 75 \text{ ft.}$$
$$10 \text{ ft.} - 12 \text{ ft.}$$

The length of the object is directly proportional to the length of its shadow.

$$\therefore x : 10 = 75 : 12.$$

$$x = \frac{10 \times 75}{12}, \text{ or } 62\tfrac{1}{2}.$$

124. $12000 – ($2000 + $2500 + $3000), or $4500 = the profit.

$2000 + $2500 + $3000, or $7500 = the capital stock.

$\frac{2000}{7500}$, or $\frac{4}{15}$ = the part of the capital stock owned by A.

$\frac{2500}{7500}$, or $\frac{1}{3}$ = the part of the capital stock owned by B.

$\frac{3000}{7500}$, or $\frac{2}{5}$ = the part of the capital stock owned by C.

The profit is divided in proportion to the shares.

∴ $\frac{4}{15}$ of $4500 + $2000, or $3200 = A's share from the sale.

$\frac{1}{3}$ of $4500 + $2500, or $4000 = B's share from the sale.

$\frac{2}{5}$ of $4500 + $3000, or $4800 = C's share from the sale.

125. $\frac{20 \times 60 \times 6086}{5280} = 1383\frac{2}{11}$, the number of miles required. (Cancel.)

126. $\sqrt{11\frac{1}{9}} = \sqrt{\frac{100}{9}} = \frac{10}{3}$, or $3\frac{1}{3}$.

127. $\sqrt{11025} = \sqrt{5 \times 5 \times 7 \times 7 \times 3 \times 3} = 5 \times 7 \times 3$, or 105.

128. $2 \times 1 \times \frac{2}{3}$, or $\frac{4}{3}$ = the number of square feet required for the top and bottom.

$2 \times 1 \times \frac{1}{2}$, or 1 = the number of square feet required for the sides.

$2 \times \frac{2}{3} \times \frac{1}{2}$, or $\frac{2}{3}$ = the number of square feet required for the ends.

∴ 3 = the number of square feet required.

129. 6 × the area of one face = the area of the entire surface.

54 sq. in. = the area of the entire surface.

∴ 6 × the area of one face = 54 sq. in.

Whence, $\frac{1}{6}$ of 54 sq. in., or 9 sq. in. = the area of one face.

∴ $\sqrt{9}$, or 3 = the number of inches in the edge of the cube.

If d = the number of units in the diagonal of a cube, and e the number of units in the edge, $d^2 = e^2 + e^2 + e^2$, or $3\,e^2$ [see p. 305, Prob. 11, sug., for method].

$\therefore\ d^2 = 3(3)^2$, since $e = 3$.

Whence, $d = 3\sqrt{3}$.

130. x lb. — $1\frac{1}{2}$ in.
1 lb. — 1 in.

The weights are directly proportional to the cubes of the radii.

$\therefore\ x : 1 = (1\frac{1}{2})^3 : 1^3$.

Whence, $x = \frac{1 \times \frac{3}{2} \times \frac{3}{2} \times \frac{3}{2}}{1^3}$, or $3\frac{3}{8}$.

131. Let A represent the number of square units in the area, B and b the number of units in the bases, and h the number of units in the altitude.

Then, $A = \frac{h}{2}(B + b)$ [§ 395].

Substituting, $160 = \frac{h}{2}(30 + 10)$.

$\therefore\ 160 = \frac{40\,h}{2}$; or $40\,h = 320$, and $h = 8$.

$\therefore$ 8 rd. = the required distance.

132. The brace is the hypotenuse of a right triangle whose base is 8 ft. and altitude 6 ft.

$\therefore\ \sqrt{8^2 + 6^2}$, or 10 = the number of feet in the required length.

133. $\frac{37}{4} \times \frac{37}{4} \times 8 \times 3.1416$, or 2150.42, nearly = the number of cubic inches in a bushel [§ 247, 2].

134. x gal. — 1.
1.5 gal. — 2.

Their altitudes may be represented by 1 and 2. The capacities are directly proportional to the cubes of the altitudes.

$\therefore\ x : 1.5 = 1^3 : 2^3$.

Whence, $x = \frac{3}{2} \div 8$, or $\frac{3}{16}$.

135. 18 ft. + 2 × $2\frac{1}{2}$ ft., or 23 ft. = the length of the floor.
12 ft. + 2 × $2\frac{1}{2}$ ft., or 17 ft. = the width of the floor.

$\therefore$ 23 × 17, or 391 = the number of square feet in the floor.
18 × 12, or 216 = the number of square feet in the rug.
$\therefore$ 175 = the number of square feet in the margin.

175 × $0.05, or $8.75 = the required cost.

136. $\frac{\overset{\overset{5}{\cancel{300}}}{\cancel{2100}} \times 3 \times 40 \times \cancel{3} \times \cancel{11} \times 1728}{\cancel{60} \times \underset{\underset{\cancel{7}}{\cancel{77}}}{\cancel{231}}}$, or 1036800 = the number of gallons required.

137. 66 ft. = 2 × length + 2 × width [§ 182].
44 ft. = 2 × length.
∴ 22 ft. = 2 × width.
∴ 11 ft. = width.
11 × 22, or 242 = the number of square feet in the area.

138. 40 × 160, or 6400 = the number of square rods in 1 lot.
$\sqrt{6400}$, or 80 = the number of rods in the length of a lot.
6 × 320 = the number of rods in the length of a township.
∴ 6 × 320 ÷ 80, or 24 = the number of lots that can be laid off along each side of the township.
∴ 24 × 24, or 576 = the number of lots.
There will be 25 fences running east and west, and 25 running north and south, each 6 mi. long.
∴ 50 × 6 mi., or 300 mi. = the length of fence required.

139. 2 × 2 × 1, or 4 = the number of square feet in the top and bottom.
$2 \times 2 \times \frac{1}{2}$, or 2 = the number of square feet in the sides.
$2 \times 1 \times \frac{1}{2}$, or 1 = the number of square feet in the ends.
∴ 7 = the number of square feet in the outer surface.
Each inner dimension is 1 in. shorter than the corresponding outer dimension.
∴ 1 ft. 11 in. × 11 in. × 5 in. = the inner dimensions.
$2 \times 1\frac{11}{12} \times \frac{11}{12}$, or $3\frac{37}{72}$ = the number of square feet in the top and bottom.
$2 \times 1\frac{11}{12} \times \frac{5}{12}$, or $1\frac{43}{72}$ = the number of square feet in the sides.
$2 \times \frac{11}{12} \times \frac{5}{12}$, or $\frac{55}{72}$ = the number of square feet in the ends.
∴ $5\frac{7}{8}$ = the number of square feet in the inner surface.
Then, 7 sq. ft. – $5\frac{7}{8}$ sq. ft., or $1\frac{1}{8}$ sq. ft., or 1 sq. ft. 18 sq. in. = the difference.

140. 3 × 3 × 6 × 1000, or 54000 = the number of cubic decimeters in the tank.
$1^{\text{cdm}} = 1^{\text{l}}$.
∴ $54000^{\text{cdm}} = 54000^{\text{l}}$, or the capacity of the cistern.

141. $20 \times 12 \times 6 \times \frac{16}{25}$, or $921\frac{3}{5}$ = the number of bushels.
Then, $921\frac{3}{5}$ × $0.80, or $737.28 = the value.

142. $2 \times (36 + 24) \times 8$, or 960 = the number of square feet in the walls.

36×24, or 864 = the number of square feet in the ceiling.

∴ 1824 sq. ft. = the total area.

1824 sq. ft. − 420 sq. ft., or 1404 sq. ft. = the estimated area.

1404 sq. ft. = 156 sq. yd.

Then, $156 \times \$0.20$, or \$31.20 = the cost.

143. $\frac{40 \times 36 \times 9}{27} \times \$0.20$, or \$96 = the cost of excavating.

$\frac{2 \times (40 + 36) \times 10 \times 1\frac{1}{2}}{24\frac{3}{4}}$, or $92\frac{4}{33}$ = the number of perch in the walls.

Then, $92\frac{4}{33} \times \$1$, or \$92.12 = the cost of building the walls.

And \$96 + \$92.12, or \$188.12 = the total cost.

144. $\frac{10}{11} \times 110 \times 60 \times \frac{3}{4} \times \frac{125}{2}$ = the number of pounds of ice.

∴ $\frac{10 \times 110 \times 60 \times 3 \times 125}{11 \times 4 \times 2 \times 2000}$, or $140\frac{5}{8}$ = the number of tons. (Cancel.)

145. $2 \times (8 \text{ ft.} + 2 \text{ ft.})$, or 20 ft. = the distance around the frame inside.

$2(8 \text{ ft.} + 8 \text{ in.}) + 2(2 \text{ ft.} + 8 \text{ in.})$, or 22 ft. 8 in., or $22\frac{2}{3}$ ft. = the distance around the frame outside.

∴ $22\frac{2}{3}$ ft. − 20 ft., or $2\frac{2}{3}$ ft. = the required distance.

Again, 8×2, or 16 = the number of square feet in the slate.

$8\frac{2}{3} \times 2\frac{2}{3}$, or $23\frac{1}{9}$ = the number of square feet in the slate and frame.

∴ $23\frac{1}{9}$ sq. ft. − 16 sq. ft., or $7\frac{1}{9}$ sq. ft., or 1024 sq. in. = the difference.

146.

$$x \text{ in.} — 15 \text{ in.}$$

$$15 \text{ ft.} — 40 \text{ ft.}$$

In similar solids homologous sides are proportional.

$$\therefore x : 15 = 15 : 40.$$

$$x = \frac{15 \times 15}{40}, \text{ or } 5\tfrac{5}{8}.$$

147. The radius of the base, the slant height, and the altitude form a right triangle, of which the slant height is the hypotenuse.

5 ft. = the slant height, and 3 ft. = the radius.

∴ $\sqrt{5^2 - 3^2}$, or 4 = the number of feet in the altitude.

∴ $\frac{4}{3} \times \frac{22}{7} \times 3^2$, or $37\frac{5}{7}$ = the number of cubic feet in the pit [§ 410, 3].

148. 60×50, or 3000 = the number of square yards in the lawn.

64 yd. by 54 yd. are the dimensions of the lawn with the walk added.

∴ 64×54, or 3456 = the number of square yards in the lawn and walk.

∴ 3456 − 3000, or 456 = the number of square yards in the walk.

$456 \times \$0.12$, or \$54.72 = the cost of graveling.

149. 2 × (60 yd. + 50 yd.), or 220 yd. = the length of hedge required to surround the lawn.

2(64 yd. × 54 yd.), or 236 yd. = the length required to surround the lawn with the walk added.

∴ 220 yd. + 236 yd., or 456 yd., or $82\frac{10}{11}$ rd. = the length of hedge required to inclose the walk.

150. 4 × 4 × 8, or 128 = the number of cubic feet.

$\frac{128 \times 173.75}{2000}$, or 11.12 = the number of tons in the weight.

151. 6 × 4, or 24 = the number of square feet required for the bottom.
2 × 6 × 3, or 36 = the number of square feet required for the sides.
2 × 4 × 3, or $\underline{24}$ = the number of square feet required for the ends.
84 = the number of square feet required in all.

152. 5280 ft. ÷ 480, or 11 ft. = the circumference.

11 ft. ÷ $\frac{22}{7}$, or $3\frac{1}{2}$ ft. = the diameter [§ 245, 2].

153. A difference of $1.10 – $0.85, or $0.25, in the cost of each yard makes a difference of $1.20 + $1.80, or $3 in the total cost.

∴ $3 : $0.25, or 12 = the number of yards desired.

Then, 12 × $1.10 – $1.20, or $12 = the money she had.

154. 212° – 32°, or 180° F. = 100° – 0°, or 100° C.
68° F. = 68° – 32°, 36° F. above freezing.
If 180° F. = 100° C., 1° F. = $\frac{5}{9}$° C.
∴ 36° F. = 36 × $\frac{5}{9}$° C., or 20° C.
Then, 36° F. above freezing = 20° C. above freezing, or 20° C.

155. 1^l of water weighs 1000^g, since $1^l = 1^{cdm} = 1000^{ccm}$.
.792 × 1000^g, or 792^g = the weight of 1^l of alcohol.

156. $1\frac{1}{4}$ A. = $1\frac{1}{4}$ × 160 sq. rd. = $1\frac{1}{4}$ × 160 × $30\frac{1}{4}$ sq. yd., or 6050 sq. yd.
6050 ÷ 121, or 50 = the number of yards in the width.

157. $\frac{132 \times 1\frac{1}{2} \times 4}{24\frac{3}{4}}$, or $\frac{4 \times 132 \times 3 \times 4}{99 \times 2}$, or 32 = the number required.

158. 2 A. = 2 × 160 sq. rd., or 320 sq. rd., the area.

$2 \times w = l.$

$w = w.$

∴ $2 \times w^2 = l \times w$, or 320.

∴ $w^2 = 160$; whence, $w = \sqrt{160}$, or 12.6492, nearly, and $l = 25.2984$, nearly.

∴ 2 × (25.2984 + 12.6492), or 75.8952 = the number of rods of fence.

75.8952 × $5, or $379.476 = the cost.

159. 10% of 412.5 gr., or 41.25 gr. = the weight of the copper in a silver dollar.

$$x \text{ ct.} - 41.25 \text{ gr.}$$

$$24 \text{ ct.} - 5760 \text{ gr.}$$

The value is directly proportional to the weight.

$$\therefore x : 24 = 41.25 : 5760.$$

$$x = \frac{24 \times 41.25}{5760}, \text{ or } \frac{11}{64}.$$

160. 20 mi. + 25 mi., or 45 mi. = the distance they are apart in 60 min.

∴ 60 ÷ 45, or $1\frac{1}{3}$ = the number of minutes required.

161. 75% of 40 lb., or 30 lb. = the amount of green tea in the first mixture.

30 lb. = $\frac{1}{2}$ of the second mixture.

∴ 60 lb. = the second mixture.

60 lb. − 30 lb., or 30 lb. = the amount of the black tea in the second mixture.

25% of 40 lb., or 10 lb. = the amount of green tea in first mixture.

∴ 30 − 10, or 20 = the numbers of pounds to be added.

162. \$650 − \$400, or \$250 = the amount spent of the \$8000 each year.

∴ \$8000 : \$250, or 32 = the number of years required.

163.

$$\begin{array}{l} \text{Wages for 20 wk.} = \$20 + \text{suit.} \\ \underline{\text{Wages for 12 wk.} = \$\ \ 8 + \text{suit.}} \\ \therefore \text{Wages for } \ 8 \text{ wk.} = \$12, \text{ or } \$1.50 \text{ per wk.} = \text{his wages.} \end{array}$$

20 × \$1.50, or \$30 = wages without the suit for 20 wk.

∴ \$30 − \$20, or \$10 = the value of the suit.

164 $\frac{6}{10}$ of 250 bu., or 150 bu. = the amount shelled by both.

∴ 100 bu. = the amount shelled by one of them in 10 hr.

Then, 10 bu. = the amount the second shells in 1 hr.

Or, 250 bu. = the amount the second shells in 25 hr.

60 bu. = the amount the second shells in 6 hr.

∴ 150 bu. − 60 bu., or 90 bu. = the amount the first shells in 6 hr.

15 bu. = the amount the first shells in 1 hr.

250 bu. = the amount the first shells in $16\frac{2}{3}$ hr.

∴ the first will shell 250 bu. in 25 hr., and the second will shell 250 bu. in $16\frac{2}{3}$ hr.

165. $\frac{1}{20}$ = the part the first fills in 1 hr.
$\frac{1}{25}$ = the part the second fills in 1 hr.
∴ $\frac{9}{100}$ = the part both fill in 1 hr.
$\frac{1}{15}$ = the part the spigot empties in 1 hr.
∴ $\frac{9}{100} - \frac{1}{15}$, or $\frac{7}{300}$ = the part that remains in the cistern at the end of one hour with the pipes and spigot flowing.
That is, $\frac{7}{300}$ of the cistern is filled per hour.
Then, $\frac{300}{7}$ hr., or $42\frac{6}{7}$ hr. = the required time.

166. $\frac{3}{4}$ of $1800, or $1350 = the insured value.
$1350 = 1.35 × $1000.
1.35 × $2.40, or $3.24 = the annual premium.

167. $\frac{\overset{22.5}{\cancel{225}} \times \cancel{200}}{\underset{\cancel{10}}{\cancel{2000}}}$, or 22.5 = the required number.

168. 2.40 × $4.80, or $11.52 = the cost of the sugar.
$11.52 + $0.40, or $11.92 = the cost of the sugar with freight.
240 × $0.5½, or $13.20 = the selling price.
∴ $13.20 – $11.92, or $1.28 = the gain.

169. 20 × 8 × $37.50, or $6000 = the amount of premiums paid.

170. $2.80 – $0.10, or $2.70 = cost of the nails.
$2.70 + $0.30, or $3 = cost of the nails and freight.
½ of $3, or $1.50 = the sum each should pay.
$1.60 = the sum A paid.
∴ $1.60 – $1.50, or $0.10 = the sum B owes A.

171. $100 + 10 × $5, or $150 = the amount he earned.
10 × 6 × $3, or $180 = the amount he would have earned had he lost no time.
∴ $180 – $150, or $30 = the amount lost by idleness.
∴ $30 : $3, or 10 = the number of days he was idle.

172. 20% of 150, or 30 = the number of boys examined.
150 – 30, or 120 = the number of girls examined.
$16\frac{2}{3}$%, or $\frac{1}{6}$ of 30, or 5 = the number of boys that failed.
20% of 120, or 24 = the number of girls that failed.
150 – (5 + 24), or 121 = the amount of pupils that passed.
∴ $\frac{121}{150}$ of 100%, or $80\frac{2}{3}$% = the required per cent.

173. $\sqrt[3]{216} = \sqrt[3]{2 \times 2 \times 2 \times 3 \times 3 \times 3} = 2 \times 3$, or 6.

174. \$0.80 + 5% of \$0.80, or \$0.84 = the cost of 1 bu. of wheat.
\$2000 : \$0.84, or 2380 = the number of bushels, with 80¢ surplus.

175. $32 \div 2$, or 16 = the number of feet in the sum of the parallel sides.

16 ft. − 4 ft., or 12 ft. = 2 × the shorter of the parallel sides.

∴ 6 ft. = the shorter of the parallel sides, and 16 ft. − 6 ft., or 10 ft. = the longer.

176. 8 men should do $\frac{1}{3}$ of the work in 2 da.
1 man should do $\frac{1}{3}$ of the work in 16 da.
6 men should do $\frac{1}{3}$ of the work in $2\frac{2}{3}$ da.

177. $100 \times 48 \times \frac{1}{6}$, or 800 = the number of cubic feet in the earth removed.

There are 2 ditches each 100 ft. long and 1 ft. wide, and 2 that are each 50 ft. long and 1 ft. wide.

Then, $2 \times (100 + 50) \times 1 \times 1$, or 300 = the number of cubic feet of earth removed when the ditch has been dug 1 ft. deep.

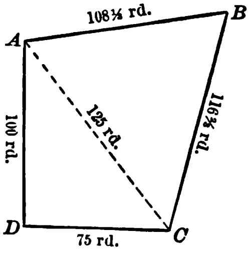
∴ $800 \div 300$, or $2\frac{2}{3}$ = the number of feet in the required depth.

178. $13^{\text{kg}}\ 598^{\text{g}}$, or 13598^{g} = the weight of 1^{l} of mercury.
1000^{g} = the weight of 1^{l} of water.
∴ 13598 : 1000, or 13.598 = the required number.

179. Draw diagonal *AC*.

Then, $\sqrt{(100)^2 + (75)^2}$ rd., or 125 rd. = *AC*.

$\frac{100 \times 75}{2}$ sq. rd., or 3750 sq. rd. = area of $\triangle ADC$.



$$\begin{aligned}&\sqrt{175 \times 66\tfrac{2}{3} \times 58\tfrac{1}{3} \times 50}\\ &= \sqrt{175 \times \tfrac{200}{3} \times \tfrac{175}{3} \times 50}\\ &= \sqrt{(175)^2 \times (100)^2 \times (\tfrac{1}{3})^2}\\ &= 175 \times 100 \times \tfrac{1}{3}, \text{ or } 5833\tfrac{1}{3}\end{aligned}$$

= the number of square rods in $\triangle ACB$ [§ 383].

∴ $5833\frac{1}{3}$ sq. rd. + 3750 sq. rd., or $9583\frac{1}{3}$ sq. rd., or $59\frac{43}{48}$ A. = the area of *ABCD*.

180. $2\frac{1}{2}$, or $\frac{5}{2}$ × one of the equal sides = 45 ft.
∴ $\frac{1}{2}$ of one of the equal sides, or the base = $\frac{1}{5}$ of 45 ft., or 9 ft.

181. $2 \times 160 \div 8$, or $40 =$ the number of rods in the length of the tract.

$\frac{8 \times 16\frac{1}{2}\text{ ft.}}{12\text{ ft.}}$, or $11 =$ the number of panels along one end of the tract.

$\frac{40 \times 16\frac{1}{2}\text{ ft.}}{12\text{ ft.}}$, or $55 =$ the number of panels along one side of the tract.

Then, $2(11 + 55)$, or $132 =$ the number of panels of fence required.

When a field is inclosed, the number of panels $=$ the number of posts.

$\therefore$ $132 =$ the number of posts required.

182. 20% of \$40000, or \$8000 = the required duty.

183. 10% of \$10500, or \$1050 = the required duty.

184. $1000 \times$ \$0.25, or \$250 = the required duty.

185. $25 \times 25 \times$ \$0.015, or \$9.38 = the required duty.

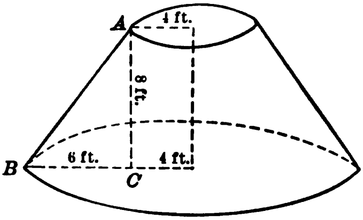
186. $10 \times 90 \times$ \$2.50, or \$2250 = the invoiced value.

$10 \times 90 \times$ \$0.60, or \$540 = the specific duty.

40% of \$2250, or $\underline{\$900}$ = the ad valorem duty.

$\therefore$ \$1440 = the entire duty.

187. The altitude, the slant height, and the difference of the radii of the bases form a right triangle, ABC, whose hypotenuse $= \sqrt{(8)^2 + (6)^2}$ ft., or 10 ft.



Then 10 ft. $=$ the slant height of the frustum.

$\frac{10}{2}(2 \times 10 \times \frac{22}{7} + 2 \times 4 \times \frac{22}{7})$, or $440 =$ the number of square feet in the lateral area.

188. \$80 = the loss on \$250 in 40 da.

\$2 = the loss on \$250 in 1 da.

$\frac{7}{5}$ of \$2, or \$2.80 = the loss on \$350 in 1 da.

\$70 : \$2.80, or 25 = the number of days \$350 was invested.

189. \$450 gained \$180 in 8 mo.

\$450 gained \$22.50 in 1 mo.

$\frac{1}{7}$ of \$175, or \$25 = B's gain in 1 mo.

\$25 = $\frac{10}{9}$ of \$22.50.

Then, B's capital = $\frac{10}{9}$ of A's, or $\frac{10}{9}$ of \$450, or \$500.